INTERNATIONAL

MARINE ENGINEERING

Published Monthly by ALDRICH PUBLISHING CO.

461 EIGHTH AVENUE, NEW YORK — 8 BOUVERIE ST., LONDON, E. C.

H. L. Aldrich, President and Treasurer
Assoc. Member of Council, Soc. N. A. and M. E.

George Slate, Vice-President
E. L. Sumner, Secretary

E. J. P. Benn, Director and Publisher
Associate Inst. N. A.

Edited by H. H. Brown, A. M. Inst. N. A.
Member Soc. N. A. and M. E.

Vol. XXIII — JANUARY, 1918 — No. 1

Stop Waste and Practice Self-Denial

"THIS war cannot be financed unless the American people immediately stop waste, practice self-denial, economize in every possible direction and lend the money they save thereby to the Government. . . . The widespread practice of economy is absolutely essential to the success of the war."—*Secretary of the Treasury McAdoo.*

To every American the recent issue of Government war saving stamps in denominations of 25 cents and $5 gives an opportunity such as has never before been offered for investing their savings with absolute safety and at attractive rates of interest. Everyone, however small his means, can help by investing in these war certificates. Every dollar thus saved will hasten the end of the devastating war in Europe.

Naval Expansion

SOME idea of the efficiency of the Navy Department and how it has met the extraordinary demands of the present war crisis can best be gained from the utterances of the Secretary of the Navy in his annual report and before the investigating committee of Congress. From a force of 4,500 officers and 68,000 men enlisted in January, 1917, the Navy has expanded to 15,000 officers and 254,000 enlisted men. Further expansions are inevitable. A year ago the Navy had 130 stations of all kinds; it has now 363. The number of employees at regular navy yards has increased from about 35,000 to over 60,000. On shore and afloat the naval establishment embraces more than 300,000. At the beginning of the fiscal year 1917 the monthly expenditures for all naval purposes were about $8,000,000 (£1,640,000); they are now about $60,000,000 (£12,300,000). A year ago there were 300 naval vessels of all kinds in commission; to-day there are considerably more than a thousand. These typical figures sufficiently indicate the task the Navy has had to accomplish in the way of expansion.

The ability of the Navy, without friction or hurrying, to bring to bear its military force rapidly and to increase it threefold in a short time, is credited by the Secretary of the Navy to the system that had been built up in peace times and to the securing before the war of a larger building programme extending over a term of years, as well as to the authorization of an increased personnel. Internally the efficient organization, working together for years as a trained team, made the Navy Department's rapid expansion easy, though it taxed the strength and energy of every department head and the entire personnel on shore and in the fleets. It goes without saying that such satisfactory progress in the fighting strength of the Navy could not have been accomplished without corresponding efficiency in the business affairs of the department, and it is largely due to the improved business methods and purchasing systems developed that the Navy Department has been able to meet the tremendous and sudden demands of war and embark upon such unprecedented programmes of construction and equipment without breaking down the business machinery of the department.

Secretary Daniels' message to the American people that "the Navy has met its duties of the present and is preparing for those of the future" will be received with confidence and no interference with the efficient work of this branch of the government will be tolerated.

Difficulties in Merchant Shipbuilding

UNLIKE the Navy Department, which had an experienced and efficient organization with which to carry forward its unprecedented expansion in recent months, the construction of the emergency fleet—a task of equal importance and of even greater magnitude—has been delegated ever since the work began to men with little or no experience or training in shipbuilding. The continued failure of the Shipping Board to make use in either executive or advisory capacities of the services of expert builders of merchant vessels is a policy for which no excuse can be offered. The frequent changes of personnel in both the Shipping Board and the Emergency Fleet Corporation, and the difficulties needlessly encountered in the early stages of the work, coupled with the lack of harmony between the government and the shipbuilders, are eloquent proof of a mistaken policy and one which the country has every reason to regret.

When all is said and done, however, the success or failure of the merchant shipbuilding programme will depend upon the securing of an adequate supply of experienced labor and competent shipyard organizations to direct it. Chairman Hurley acknowledges this and points out that the Emergency Fleet Corporation is at present controlling work in 132 shipyards, of which only 58 were in existence a year ago, while 74 are new plants. An encouraging indication of progress is found, however, in reports from 109 shipyards, which show that during the nine weeks beginning October 6 the number of employees has increased 45.2 percent.

Gross and Deadweight Tonnage

DUE to the fact that figures relating to the tonnage of merchant shipping building for the Shipping Board are given in deadweight tons, while the figures for vessels building in Great Britain, and as formerly given for the American merchant marine by the Bureau of Navigation, were in gross tons, much confusion has resulted in the minds of the public as to the comparative production of merchant vessels in this and other countries.

The gross tonnage of a vessel is an arbitrary figure

representing the volume of a certain portion of the internal capacity of a vessel, together with the volume of a portion of its erections expressed in tons of 100 cubic feet each. The net registered tonnage of a vessel is the gross tonnage reduced by an arbitrary amount of volume supposed to be devoted to the propelling machinery and of certain spaces devoted to the use of the crew. On the other hand, the deadweight tonnage of a vessel is the measure of a portion of the displacement to a certain draft available for the carriage of cargo, fuel, water, crew, stores, etc., expressed in tons of 2,240 pounds. In order to use deadweight tonnage as a fair method of comparison between vessels of the same type, it is necessary that the draft should be determined. This is done in Great Britain by the adoption of a table of freeboards which limits the draft for each particular vessel. Again, in figuring the deadweight tonnage sometimes the water in the boilers is excluded, while at other times the water is included.

The net tonnage is used by all the maritime nations of the world and is supposed to represent a measure of the earning capacity of the vessel. If deadweight tonnage were used, it would probably be also with the idea of representing the earning capacity of the vessel, but consideration of this question will show that the earning capacity of the vessel is sometimes dependent upon the cubic capacity available for cargo, sometimes upon the deadweight capacity available for cargo, sometimes upon the speed of the vessel, sometimes upon the amount of fuel that can be carried and sometimes upon the amount of space available for passengers. Comparative figures, therefore, should be examined with care, and consideration should be given to the conditions upon which they are based, as otherwise the figures will be misleading.

The Lighthouse Service

ACCORDING to the annual report of the Commissioner of Lighthouses to the Secretary of Commerce for the fiscal year ended June 30, 1917, the United States Lighthouse Service maintains aids to navigation on all coasts under the jurisdiction of the United States, except the Philippine Islands and Panama, and also on the principal interior rivers. This Service is charged with the maintenance of aids to navigation along 47,192 statute miles of coast line and river channel. On June 30, 1917, there were 5,796 persons employed in the Lighthouse Service, including 122 technical force, 149 clerical force and 5,525 employees connected with depots, lighthouses and vessels. During the fiscal year there was a net increase of 275 in the total number of aids maintained, the total at the end of the year being 15,223. Of these 5,420 are lights of all classes and 588 are fog signals. The total number of aids in Alaska, comprising lights, fog signals, buoys and daymarks in commission at the close of the fiscal year was 416, including 159 lighted aids.

During the fiscal year 50 tenders and 68 light vessels were in commission. The new tenders *Palmetto* and *Cedar* were completed and immediately placed on duty. Two new light vessels were completed during the year; *No.* 101 off Cape Charles, entrance to Chesapeake Bay, Va., and *No.* 102 at Southwest Pass, entrance to Mississippi River, La. Light vessels *No.* 99 for relief duty on the Great Lakes is under construction.

During the fiscal year 1917 services in saving life and property were rendered and acts of heroism performed by employees of the Lighthouse Service on 160 occasions. Recommendation is renewed for legislation authorizing the retirement of employees of the Lighthouse Service on account of age or disability incident to their work, which is the practice of the lighthouse services of many other countries. A bill providing for the retirement of aged persons in the Lighthouse Service was passed unanimously by the Senate in April, 1916, but was not acted upon by the House of Representatives. Recommendation is also made for an increase of salary for lighthouse inspectors, who are considered underpaid in view of the important responsibilities borne by them.

The appropriations for the maintenance of the Lighthouse Service for the fiscal year 1918 are $5,338,680, being $99,650 in excess of those for the preceding fiscal year. In addition there are special appropriations aggregating $1,299,300 for various new works.

Fuel and Our War-Bred Merchant Ships

WHEN we plan things in the United States we do so in a typical American way, which is only another way of saying that we plan them bigger and on a larger scale than is done in other countries. This is particularly true of the programme now well under way by the Shipping Board for the construction and operation of a colossal merchant tonnage to be built and equipped under adverse conditions as regards labor, material and personnel, and complicated further by the urgency of early completion, made necessary by the ravages of the present war.

Progress has been made not only in closing contracts for the construction of these ships, but also in building up organizations which have under way the construction of immense shipyards, in which fabricated ships are to be turned out at a very rapid rate. This has been accomplished in spite of delays at the inception of this project, due almost entirely to the legislation which created the Shipping Board. A large proportion of the preliminary work necessary to these various undertakings has been completed and the balance, we are confident, will be started in the very near future.

The first thought in the construction of these ships has been their early use in carrying on the plans of the Government in the prosecution of the war—they will unquestionably be used for this purpose until the cessation of hostilities. After the war a very large percentage of them will enter the commercial field under the American flag, and in competition with the merchant fleets of other maritime countries. It is to this phase of the work of these vessels, as well as to their war service, that attention should be directed.

The planning and construction of the major portion of the Shipping Boards programme had as predominant motives in design the question of rapid construction, sustained speed, safety against hazards of the sea, minimum material for hull and fittings and simplification of parts. That these requirements, all tending towards an early commissioning, have been well thought out and provided for will not be questioned.

The comparatively recent general knowledge of the fuel situation existing in this country, coupled with the fact that America must play a leading part in supplying fuel to the allied countries, makes it pertinent to consider what effect the commissioning of these ships will have on our fuel problem.

There are approximately 1,400 ships that will go into service under the Shipping Board's programme during the next two years. There will be required not less than 8,000,000 tons of fuel per year to operate these ships. The fuel production in the United States during 1916 was 502,520,000 tons of bituminous coal, 87,580,000 tons of anthracite coal, making a total coal production of 590,-

100,000 tons. The fuel oil production was approximately 300,000,000 barrels. The production during 1917 is estimated at 553,000,000 tons of bituminous coal, 97,000,000 tons of anthracite coal, making a total of 650,000,000 tons of coal. The fuel oil production will not greatly exceed 310,000,000 barrels.

The demands upon our fuel supply for industrial purposes of our own, as well as for the commercial and domestic requirements of the allied countries, will certainly be much greater than during the past year. In 1917 we lacked fully 200,000,000 tons of supplying the demands placed upon us, and during 1918 this excess of demand over supply will at least be doubled. It is, therefore, necessary that anyone who is directly, or indirectly, concerned in the use of fuel give the greatest attention to means for conserving both coal and fuel oil.

Turning to the railroad situation in this country—for the reason that the railroads consume something more than 25 percent of the bituminous coal produced in the United States—it is very apparent that all railroads and all those concerned in the design of steam locomotives and power plants are going to great length to increase the power produced per pound of fuel. A recent bulletin by the Chamber of Commerce of the United States very tersely sums up this question by saying: "The man who wastes coal to-day is an enemy to mankind," and likens the situation to that of people in an open boat at sea with a limited supply of food.

The Railway War Board, composed of executives of the leading railroads of the country, recently issued a bulletin containing specific recommendations which they urged all railroads to adopt as fuel conservation methods. Many of these recommendations had to do with the instruction and education of those handling fuel, and might be considered axiomatic to those who had given any thought to the problem. A number of other recommendations related specifically to improvement in the design of equipment for burning fuel, and earnestly recommended the adoption of devices that had well demonstrated increased fuel economies. Among these were feed-water heaters, improved methods of combustion, high-degree superheaters, specially designed grates and improved draft conditions. It is a fair query as to whether or not equal attention has been given on the part of the Shipping Board to the use of such of these devices as may be adaptable for marine installations.

Without question, the reciprocating engines and turbines of a modern ship are more economical in the use of steam than are the simple, non-condensing engines universally used on locomotives. The boilers in merchant ships are also at least equal in efficiency to those used on locomotives, although the water evaporated per pound of boiler weight or per square foot of heating surface is undoubtedly very much lower, due to the fact that marine power plants are not operating at such a high duty. The question of boilers has also, in the present emergency, been complicated by the impossibility to get sufficient quantities of steel to carry out the original plans and, therefore, a varied boiler construction will have to be used.

There has been little definite information available as to the contemplated use of highly superheated steam, but there should be no reason to doubt the intention to adopt this well-established means of fuel saving. It is also probable that all of the features ensuring improved combustion and better draft conditions that railroads have developed so largely in the past ten years, have been adopted as far as conditions permit. Feed-water heaters, we believe, are being installed as a standard.

It is the extremely critical situation as regards the world fuel supply that justifies continued efforts to arouse the thoughts of everyone to do his part in preventing, so far as may be possible, a shortage in these commodities which not only are the life-blood of our own industrial world and of our domestic happiness, but in the present world struggle have such a tremendous effect on the successful prosecution of our part in the conflict.

Deficiency of Coal in 1918 May Amount to 130,000,000 Tons

IN discussing the general need of fuel conservation in the boiler rooms, Van. H. Manning, director of the Bureau of Mines, Department of the Interior, recently issued the following statement:

There is one phase of the present coal situation which may put an entirely different light on the supposed increased production of coal of the present year. In round numbers there was produced 600,000,000 tons of fuel last year. Statement has been made that 50,000,000 more tons will be mined this year. The preparation of this increased quantity of coal has not been as good as in times past. Analyses of samples show in many cases a greatly increased quantity of ash. Repeated cases are brought to the attention of the Bureau of Mines where coal which would run from 6 to 8 percent ash in normal times is running from 12 to 18 percent of ash in these abnormal times. Complaint about the preparation of coal is very general, and it is not at all improbable that 5 percent more ash is included in this year's coal than in previous years. If such a figure is true, it means that 32,500,000 tons of the estimated output of 650,000,000 tons is nothing but increased ash. If we can imagine over 600,000 carloads of ash being added to the present burden of transportation, the evident effect on car supply and transportation troubles would be seen.

If this were the end of the matter it would not be so bad, but there is another factor well known to engineers which is apt to be overlooked by the non-technical user. The extensive experiments carried on by the Government at the St. Louis Exposition showed that with the coals used there was a decrease of about 1½ percent in efficiency for each 1 percent addition to the ash content of the coal—that is to say, the inclusion of more ash with the coal decreases the value of the fuel not only the amount equal to the useless ash, but it makes the remaining good coal less effective to the extent of 1½ percent for each 1 percent of ash. The inclusion of 5 percent more ash in the fuel, therefore, means a reduction in efficiency of the remaining good coal of about 7½ percent, which, added to the 5 percent useless ash, makes a total reduction in effectiveness of 12½ percent.

According to this point of view, although 650,000,000 tons may be produced in 1917, its effectiveness, as compared with previous years, is probably about seven-eighths of this, and equivalent to a production of normally prepared coal of about 570,000,000 tons. We have, then, instead of an increased production as compared with last year, an actual decrease of effective coal of about 30,000,000 tons. If this is added to the estimated increased needs, due to our accelerated activities, of 100,000,000 tons, we have a deficiency of the equivalent of 130,000,000 tons, instead of 50,000,000 tons to make up by good engineering and true fuel conservation in the boiler room.

LETTERS TO THE EDITOR

Co=Operative Management

On page 428 of the October issue, Mr. Arthur F. Johnson writes most interestingly on a subject of major importance to all its readers. Knowing that the pages of this journal are read very carefully by shipbuilders, I make bold to set down my views here on the subject of co-operative management, or, more broadly speaking, the relations between employer and employee.

From a long and varied experience in this and other countries, I am forced to take views diametrically opposed to those of Mr. Johnson. His views are broadly that the employer should assume the rôle of parentalism with those whom he employs. I assert that this is not wise or to the liking of the employed. The employer should provide comfortable and sanitary surroundings for his help and the employee should carry out his work according to the direction of his employer and receive therefore the agreed wages for salary. After that honors are easy. The workman does not live who is not more content to go and buy his pleasures, recreation or education as he wants them than to be guided in any of these advantages by the men for whom he works. It is natural to believe, and is true, that the firm or employer who is able to erect social halls and out of the earnings of his employes provide educational advantages must be able to pay higher wages if he leaves these supposed philanthropic actions uncarried out. Any group of employers would not be pleased—in fact, would resent—interference by employees in their own social or educational actions, and what is sauce for the goose is sauce for the gander.

There are conditions where a works situated in the country might wisely provide these supposedly advantageous adjuncts, but in almost all the cities and towns of the United States can be found night schools run by the authorities where mechanical drawing and other studies can be undertaken by an employee of any works within the limits of the city or town. These night schools, I know from a long experience of running them, are attended by the most meager percent of workmen. The libraries are used very largely as places of rest by workmen, but the great majority of books to be found there are taken out by women and are not usually of an educational character.

I differ entirely from Mr. Johnson in his opening sentence. It is not lack of understanding between employer and employee which makes manufacturing difficulties as regards labor, but the desire of the workman to get higher wages and the disinclination on the part of the employer to pay them. I have met and conversed with men who agree with Mr. Johnson, but in all cases these men have been in the employ of some large company carrying out the ideas Mr. Johnson suggests, but as in so doing they make their living it is only natural that they should hold such views. I have never met an employee who did not positively and emphatically assert that he would be far more content to be paid higher wages, and with them pay for his education and amusement. What men will work hardest for is a financial gain. It was put to me once in this way: I gave an old blacksmith an order to make a lot of safety valve levers. He turned out about thirty a day. I then offered him a piecework price and he turned out over ninety. I brought this difference to his attention and asked him if he thought it just fair. "Well," he said: "Mr. Forbes, it's just this vay. When I pounds for you I pound so hard, but when I pounds for myself I pounds just as hard as I can." This old fellow was a Swede and I think he put the case in a nutshell.

It seems ideal to have workmen interested, financially, in the firm for which they work, and, in a certain way, it is; but a stockholder—even a minority one—can in many States demand access to the books of the company, and in so doing obtain information which, if given out, would be extremely useful to friendly rivals, and therefore to a disadvantage to the company. Where workmen have owned stock I have generally found them apathetic as to how the company was run, apparently having the feeling that the company would pay no attention to anything they might say, and far too often they seem to hold the idea that in owning stock in the company it is a preventive to their discharge and that liberties can be taken by them on that account.

Dividing profits among workmen presents few difficulties, but any attempt to make workmen divide losses is extremely difficult. Yet it is as fair on one side as on the other. The workman's argument against paying any losses is that, having no voice in the management of the company, it is unfair to charge the losses to them; yet if workmen will exert themselves to turn out work rapidly and well, they can prevent losses. Nothing would make workmen exert their best efforts more than a clear understanding that if they failed to get out the work quickly and well the loss would fall upon them. I know of one system which worked admirably in regard to dividing profits with the men, but in this case no losses were made and the business was very prosperous.

The system was this: A ship was bought for trading between ports in the Mediterranean. The sailors and officers of the ship were paid their regular wages and the investors eight percent on their money. The surplus over and above this had a certain amount taken from it for emergencies and the balance was divided not only with the officers and crew, but with the investors. The basis on which this was done was that every dollar of investment and the yearly pay of the officers and crew were added together and the undivided surplus was divided by this amount. This gave what was called a working interest for every dollar invested and each dollar paid as wages. In this way an officer getting $600 a year would get an additional amount obtained by multiplying the amount of his salary by the working unit.

This was satisfactory both to investors and employed—in fact, it worked so well that the system was employed by a large line of steamers. It had the great advantage in my mind of placing in the hands of the wage earners their own earned money, with which they could buy stock or any security they might desire, and there was no coercing, so to speak, to make the men buy stock of the line. It may be said, of course, and quite truly, that the sailors would waste the money and buy no securities at all, but in foreign countries workmen seemed to grasp the idea more clearly than they do in America that it is wise to save.

Mr. Johnson says that it is to the advantage of a firm to take an interest in the doings of its employees outside of business hours. It is, in my opinion, none of the firm's business. Reverse the conditions and how does it look?

Again, Mr. Johnson says that by certain actions the workmen are encouraged to make known their grievances. I think most proprietors will agree with me that no encouragement is needed on this point.

On the rule question I again entirely disagree with Mr. Johnson. The best run shop that I ever saw had no rules or regulations whatever. The men know at what hour to

come to work and when to quit, and if their action at any time was detrimental to the interest of the company the foreman spoke to them about it. This was far more effective than posted rules.

A coddling system has never prevented strikes or made a better feeling between employer and employees. There is no panacea save one, and that is gradual improvement of human nature. Finally, the only real encouragement to men at the present time is good pay now and a prospect of getting more pay by and by.

New London, Conn. W .D. Forbes.

"The Return to the Reciprocating Engine"

The criticisms brought out by Mr. F. S. B. Heward in the December issue, regarding the editorial on the above subject published in the November number are very interesting, but I do not think Mr. Heward's criticisms are in all cases justified or borne out by the actual facts of the case. I am, of course, writing from a purely turbine engineer's standpoint and writing in defense of the turbine, particularly for auxiliary drive.

Before going into detail regarding these small machines there is one statement that Mr. Heward questions in connection with the main turbine drive, which I think an investigation would show was correct as given in the original editorial, namely, that the gear capacity of the country *is* taxed to the limit. I have been informed by various shipbuilders that in view of the fact that they cannot obtain gears, they have been obliged to redesign the turbines so they can be direct connected to the propellers for the sole reason that they were unable to obtain gears.

The same story has been told by the contractors for merchant ships, and on account of the comparatively uneconomical operation of a direct connected turbine the reciprocating engine has been adopted for this one and only reason.

Referring to Mr. Heward's comments on reliability, I think the author of the original article referred particularly (when talking about reliability) to the auxiliaries. Mr. Heward says: "Exception is taken to the statement that 'the turbine is obviously better adapted for this duty . . . than the reciprocating engine,' and it is an open question whether the foreign navies have appreciated this fact and have switched over from reciprocating engines to turbines wherever possible for this one reason. . . . To couple this remark with the above statement is a very broad and positive assertion which, in the opinion of the undersigned, lacks foundation. I would like to refer the writer to Capt. Dyson's article on page 545 of the same issue. Referring to steam-driven blower sets Capt. Dyson states: "One of the great sources of failure to hold high speed for any long-continued period of time with all classes of vessels had been the continually recurring breakdowns of forced draft blowers with engines of the reciprocating type. These had been done away with, and blowers driven by electric motors substituted for battleships, beginning with the *Michigan* and *South Carolina*, as already stated. . . . Fans by later performance (referring to turbine driven fans) instilled such confidence that no other type of blower than that of the turbine driven has since been considered for destroyer work, and in later vessels of other types it has even shouldered the electric driven fan out of the way, as its flexibility of control is so much greater."

Now this statement is not from a turbine engineer, but from one whose knowledge is based on the actual performance and one whose authority to talk on this subject is beyond question.

It would take too long to go into detail regarding the gradual elimination of the reciprocating engine by the steam turbine on board the United States government ships. But it is sufficient to say that the turbine driven auxiliaries are given preference in the Navy wherever they can be practically used.

Referring to the statement made by Mr. Heward that the foreign countries have not switched over to turbine drive as indicated in the original editorial, let me cite the following facts. The marked success of turbine driven fans for destroyers resulted in the designs for these identical machines being purchased by Yarrow & Company, of Scotstoun, Glasgow, who have since that time used this drive as standard. Other builders have been developing fans along similar lines and for forced draft work both in torpedo boat destroyers and steam-driven submarines, turbine fans are, I believe, the only type adopted.

This same design has also been adopted to a large extent by the Italian Navy, and in this instance a great number of the turbine fans were manufactured in this country. The type of fan used to a great extent by the German Navy is shown in the Transactions of the Society of Naval Architects, Vol. XXIII, plate No. 76.

For generator drive the steam turbine is absolutely standard now with all modern navies.

Referring to the merchant marine, while the introduction of the turbine up to the present time has not been so universal as in the navies, we see a bigger demand for this type of auxiliary every day.

Referring to the statement of Mr. Heward: "Undoubtedly the turbine draft gear would not require as much space and would be somewhat lighter, but does its present design meet with the requirements of steady and continuous running and does the usual type of fan supplied at these high speeds actually meet forced draft requirements?" I think that this could not be better answered than by the quotation of Capt. Dyson's referred to above.

Referring to the question of personnel, I heartily agree with Mr. Heward that the authorities at Washington are not going calmly to turn over the operation of the new boats to men without experience, but one cannot help but form some opinions on this subject when in practically every paper we see this question is brought up as to how we are going to man these boats efficiently. It is true that the men will be trained and trained as well as circumstances permit, but if shipbuilders can help the situation any by fitting their boats with apparatus that is acknowledged by such an authority as the Navy Department to be more reliable and require less attention, then it would seem that the best thing to do would be to help the situation by adopting this apparatus.

W. J. A. London.

The Steam Motors Company, Springfield, Mass.

Loss of Merchant Tonnage.—According to figures supplied by the Patriotic Education Society, Inc., Washington, D. C., the loss of world's tonnage up to September, 1917, actually amounted to 12,000,000 tons, although the destruction by submarine and mine was only 8,783,080 tons. This is figured by estimating the unusual depreciation due to the exigencies of war and including the ships that are held in port, as well as the falling off in the world's tonnage. If the war had not intervened, it is estimated that the world tonnage in 1917 would have been about 59,000,000 gross tons.

Manning the New Merchant Marine

All American Merchant Ships, Except Troop and Supply Ships, To Be Manned by Merchant Officers and Seamen

IT has been announced by the United States Shipping Board that, through co-operation with the Navy Department, the Board has worked out a plan for manning the new merchant marine by which it is expected that all interests involved in the great task of transporting and supplying our armies overseas will be adequately protected.

By this plan the bulk of vessels under the American flag, whether engaged in the transatlantic trade or elsewhere, so long as they retain their character as merchantmen, will continue to be manned, as hitherto, by merchant sailors. This is in accordance with the practice followed by the British, which is held to have worked out satisfactorily under war conditions.

Troop ships and vessels carrying whole cargoes of munitions or supplies for the army and navy, however, for military reasons will be manned by naval crews.

Naval Crews for Transports Only

This plan is expected to provide a practical solution of a problem that has troubled both the Navy Department and the Shipping Board for several weeks past. It appears to meet the practical demand of the Navy for naval control of vessels doing naval duty, while, in preserving the civilian character of crews on all other vessels, it follows the best traditions of the American merchant marine.

Tentative proposals, that in the interests of discipline all vessels crossing the North Atlantic into the war zone be manned by naval reservists, were the subject of several recent helpful conferences between naval officers and representatives of the Shipping Board.

Acting on the plan evolved, which is the result of mature deliberations, the Shipping Board has adopted a comprehensive programme for securing and training civilian crews that will be needed on the new fleets of the merchant marine.

Fifty Thousand Men to be Enrolled

The Shipping Board will proceed, through its Recruiting Service, of which Henry Howard, of Boston, is the chief, to enroll men in all the States for the merchant service, to a possible maximum of 50,000. Headquarters for enrollment will be at the Boston Custom House, while the home station of the training squadron will be at the Federal Dock, East Boston.

Training Ships

Two steamers have been taken over by the Shipping Board for use as training ships. They are the *Calvin Austin,* a Boston passenger vessel, which in the past week made a mercy voyage to Halifax, and the *Minnesota,* a large passenger steamer from the Great Lakes. As the *Minnesota* met with an accident in New York waters recently, the *Austin* probably will be the first commissioned as a training ship. It is possible that as the work advances other ships, based on other ports, may be put into service.

Each of the two ships named will accommodate a "class" of 600 men, who will be subject to systematic and intensive schooling, each in his particular line of work, under a plan that has been worked out in detail by the Shipping Board's Recruiting Service, and has just received the official approval of the Board.

For the seamen the most important training will be in lookout work, lifeboat drill and fire drill. They also will be taught knotting and splicing of hawsers and wire ropes, and the routine of work about ship at sea. This instruction will be imparted by able seamen employed as instructors, each having under him a squad of ten men. By this method it is expected that the instructor will be able to impart to his pupils in a month as much knowledge of seamanship as the average green man would get in several months of ordinary seagoing. This instruction will be given largely at sea, as the men will be taken out for frequent trips offshore to harden them to sea life and to "get their sea legs on."

Instructions for Engine Room Crews

The engine room men—firemen, oilers and water tenders—will be trained on the same system, with an instructor to a small group of men.

Cooks and stewards will have actual work of preparing meals for the crew, under the direction of seasoned sea cooks.

Men who have had seagoing experience will be given precedence in the selection of the new crews, and the best trained among them will be encouraged to enter the Board's training schools for merchant officers, thirty-eight of which have been in operation since last June in different parts of the country.

Men without sea experience will also be enrolled. Any citizen between 21 and 31, in good health, is eligible for this service. Men accepted will be given $30 a month training pay, transportation to the point of training, an outfit of clothing, and board.

Wage Scale

The men trained will be added, on a fixed percentage basis, to crews formed on a nucleus of veteran seamen. When shipped for sea duty they will be paid on the standard wage scale of the merchant marine, the highest in any seagoing service in the world. Crews crossing the Atlantic now receive a war bonus of 50 percent on their wages, making the earnings of seamen or firemen $90 a month; of a quartermaster or boatswain, $105 a month; of an oiler or water tender, $97.50 a month, and of cooks, as high as $112.50 a month, with food and lodging furnished.

Co-operation of Merchant Officers and Seamen

In formulating its plan for manning the new ships, the Shipping Board has had the co-operation of organizations of seamen and officers now in the merchant service. As early as last May the Board approved a plan proposed by the Seaman's Union for adding sailors to existing crews for training. This has been followed successfully and will be continued in conjunction with the present plan.

Structural Steel for Ships.—The Carnegie Steel Company, Pittsburgh, Pa., has issued a sixteen-page pamphlet giving the standard practice recommended by American steel makers as adopted by the Emergency Fleet Corporation for structural steel for ships.

The Shipbuilding Situation*

Constructive Criticism of Relations Between the Government and Shipbuilders—Recommendations

BY JOSEPH W. POWELL †

TO-DAY our first thought in talking of ships should be the Navy and its programme. If any one had predicted seven months ago, when war was declared, that to-day would find the Navy's programme in the condition that it occupies, his forecast would have been viewed with utter incredulity. It is not permitted to say just how extensive this programme is, but the business spirit that has actuated the Navy Department in its handling of the situations produced by our entry into the war has met the utmost that could have been expected. One instance which may be cited as indicative of the expedition and effectiveness with which the Department business has been transacted is the fact that the biggest single contract that has ever been settled as a single order anywhere in the world required just two meetings of a total of four hours' sittings to negotiate. This contract will stand as a model for any other Government business.

Dealings With Navy Department Satisfactory

The desire to achieve results, to deal fairly with the contractor while safeguarding the interests of the Navy, has made this business something that is only contemplated by those who are taking part in it with the greatest of pleasure, and there is no man who is dealing with the Navy Department who will not concur in my statement that more prompt and courteous treatment, more satisfactory and expeditious business, can be done with that Department to-day than with any other branch of the Government. In passing, it is of interest that this has been accomplished without change in the Department's organization, and that barring its really serious shortage in personnel there seems little limit to the volume of work that it is prepared to handle with the facility and dispatch so necessary to the result that must be obtained to meet the situation.

Interests Not at Odds

In our association with the Navy Department during the last few strenuous months there has been borne in upon both contractor and Department the fact that their interests were not at odds, but were really the same, and that there has grown up a mutual understanding and appreciation, a mutual respect and confidence that can only result in the greatest good for the country at this time. Moreover, the Department has done that wisest of things, when results are desired; they have so far met with the proper requirements of the situation as to leave the responsibility for results in the hands of the shipbuilders, so that, barring the labor situation, if we fail to perform, there are no valid alibis that we can claim. I am proud to say that in its progress toward material preparedness the Navy Department leaves little to be desired; and as the months go by and the results begin to be achieved, our Navy will be able to occupy the commanding position that is so essential to the safety of this nation.

For many years the shipbuilding business in this country was big enough to be a target for politicians and labor leaders, but not big enough to be a power. To-day it has come into its own, and with the growth of public sentiment in favor of a merchant marine, it should in future be able to speak with no uncertain voice. At a recent conference in Washington, five shipbuilders sitting around the same table represented a business employing no fewer than 50,000 employees, and where a year ago there were hardly more than 70,000 men engaged in shipbuilding in the United States, the demands for the year 1918 will require upward of half a million men in this country.

Shipbuilding Industry Should be Represented in Council of National Defense

Nothing is more vital to-day to the success of the allied cause than the rapid production of merchant ships in the shipyards of this country. Is it not strange, therefore, in the light of this situation, that there is no member of our business on any of the advisory boards in Washington who can speak with the voice of authority in high places? There are to-day available a number of men of vision, experience and business ability who might represent this industry on the Council of National Defense, gentlemen who will measure fully up to the high standard of the other members of that Council, and I hope that in the Society of Naval Architects and Marine Engineers a motion will be made and unanimously carried to petition the President of the United States for the good of the nation to appoint such a representative.

Two Million Gross Tons Probable Output of Merchant Vessels in 1918

In speaking of the Shipping Board, the enormousness of the Emergency Fleet Corporation is little conceived by the general public, nor is it generally realized how difficult a task has been assigned to various gentlemen who have been in control of this company to build up a working organization that is capable from a technical and a business standpoint of handling the affairs entrusted to them. There are one or two matters, however, bearing upon the Corporation's business which should be discussed.

In the first place, a measure of performance is being set for our industry which is quite impossible of achievement during the coming year. In 1916 there were about 550,000 gross tons of shipping turned out in the shipyards of the United States. Last January I predicted that this year would see about 1,250,000 tons of shipping, but various labor and material conditions have arisen to reduce its output so that, while it is difficult to speak in view of the lack of official reports, I do not believe that the gross tonnage that will be completed this year will very much pass the three-quarters of a million mark. Next year the old line yards will, to a large extent, be serving the Navy, so that the total merchant ship production from them will be actually less than in 1917, so that the bulk of the increase in merchant vessels must come from new yards, the most important of which are still far from ready to lay their first keel. It is my sober judgment that a production next year of 2,000,000 gross tons will be a record of which our industry can be proud, and that this mark will not be achieved unless labor and material conditions are far better in control than has been the case during the present twelve months.

---

* Extracts from address delivered at annual banquet of Society of Naval Architects and Marine Engineers, New York, November, 1917.

† Vice-president Bethlehem Shipbuilding Corporation, South Bethlehem, Pa.

Please note that ships built have always been reported as gross tons, and not "deadweight" tons. Great Britain's maximum output of 3,000,000 tons was measured in gross tonnage. The submarine sinkings have been reported in gross tonnage, and in order to keep this issue clear, the tonnage turned out in this country should be reported on this basis, and not on the basis of deadweight carrying tons, the only effect of which is an apparent and not a real increase. For instance, the 2,000,000 gross tons which I have mentioned can be called 3,000,000 deadweight tons, but the cubic capacity of the ships, which is the recognized measurement capacity for cargo, is the same in either case.

Difficulties With Emergency Fleet Corporation

There is a second matter upon which I wish to touch. There has recently been appointed a board of five members representing the Atlantic Coast Shipbuilding Association, whose duty it is to confer with the Emergency Fleet Corporation on matters affecting our industry. If this board acts wisely and if its counsels are received in the spirit in which they are given, it is my belief that a very decided step will have been taken towards smoothing out the numberous difficulties and misunderstandings between the Fleet Corporation and the shipyards. Shipbuilders are not thinking primarily of profit to-day, but no sane man can continue to run a business who does not pay sufficient attention to this important factor to be sure that his returns will permit his business to live. No sane man can blindly enter into contractual obligations to perform the impossible or to control the uncontrollable. I believe the most important question before the Fleet Corporation and the shipbuilders is the establishment of mutual confidence and esteem, and these through the Committee are now in line for a solution that will permit the shipbuilders to spend more time at home building ships and less time in Washington at fruitless conferences. And this leads up to the last and most important of the questions which must be considered.

Shipbuilding a Question of Labor

The performance of shipbuilding during the next twelve months is going to be the performance of labor. If this is labor's war and labor is in it to do its share, the next twelve months will see astonishing results. I personally believe in the individual American workman; when I talk to him alone, or in small groups, I find him reasonable and fully competent to understand the necessities of the situation. It is my belief, based to a small extent on personal observation and to a larger extent on the evidence of people who have been closely associated with them in Washington, that most of the national labor leaders are sincere in their desire that labor shall do its proper part in the war. But labor itself is really difficult to control. Let me cite two instances:

Labor Troubles

Some three weeks ago, because of a question of rerating in the Fore River machine shop had not been handled to the liking of the men, without ever conferring with the officers of the company some 1,200 men laid down their tools and walked out of the yard, thereby stopping absolutely the most vitally important work under way for the Navy. I was informed from Washington in less than twenty-four hours that telegrams had been sent from the labor leaders there directing the members of the International Association of Machinists to return to work pending a settlement, but the actual representatives of the union on the ground by their individual efforts were able to defeat a motion that was made to this end and to hold the men out for several days more, until they finally agreed to an arbitration which the company would have been entirely willing to offer its men without their ever leaving the yard for one moment.

You have all read in the last few days of the orders that have gone forth from Buffalo to the Boston unions to return to work on certain war jobs at the Watertown Arsenal and Navy Yard. You may also have noticed that this order was disobeyed, and this for the reason that while the various trades in Boston are each members of the American Federation of Labor there is a local federation made up of the various Boston trade union bodies, known as the Building Trades Council of Boston, which is not a member of the American Federation of Labor, and which gives little or no allegiance to it. It also exercises a closer control on the various trade unions than the national society, and has so far been able to defy the orders from the national union officers. The net result of this is that there are no responsible heads with whom dealings can be carried on and who can deliver the goods. The only point at issue in these strikes, which are sympathetic, is the forcing of a building contractor who has always operated open shop in Boston to change to closed shop.

Campaign of Education

Now the proposition becomes one of the most practical importance and one that only can be immediately solved, in my judgment, by a campaign of education. If Vance McCormick were called to take charge of such a campaign as this country has never seen in any political era, if he were called to enlist under him without respect to politics or creed those men who have demonstrated their abilities to carry home to the crowd the thoughts that are uppermost in the minds of men to-day, if Oscar Underwood, Theodore Roosevelt, Champ Clark and William Howard Taft and hundreds of men of ability and forcefulness could be enlisted to go into every shipyard and munition plant to talk to the men and to bring home to them the fact that this is their war, I believe it is possible to eliminate the troubles with which we are now confronted. This is no time for industrial disputes. No plant engaged in building ships can refuse a demand from the Government to accept arbitration on questions of wages raised by its employees, and no more can any body of employees refuse to meet the situation in the same spirit. If this cannot be accomplished, these vessels upon which we are working to-day will still be built, but they will be built by the American workmen for the German Kaiser, and not for our great country, these United States of America.

Another Influential Force

There is another force that will aid in this campaign as time goes on—the influence of mothers and fathers and brothers of the men who are offering their lives in this country's defense. A man in the Fore River blacksmith shop only a few days ago said to me: "Mr. Powell, I have four boys in France. Do you think I am going to strike?" And as our dead and crippled soldiers call out to us that the rights of the men at the front to materials with which to make their fight must be met, the force of mighty public opinion will more and more make itself felt.

A few nights ago, at a meeting of the Economic Club in Boston, when a long discussion had taken place on the rights and attitude of labor and capital towards this war, when much had been said of the sacrifices that both were making, Dr. Eliott closed the evening's proceedings with a brief and eloquent address. He said, in substance, that for either capital or labor to talk of sacrifice at this time was futile; that there was only one sacrifice—that made

by the man who offered his life and his health for the salvation of the nation.

Now we must make the workmen feel these facts, and to start the campaign of education the Bethlehem Shipbuilding Corporation will head a list to defray its expenses with a generous subscription, and I will personally subscribe to the extent permitted by my means.

And if labor can be brought to that frame of mind where it will work six days a week instead of a little more than four days and a half, will give one hundred percent production instead of seventy-five, will go wholeheartedly into this mighty game, then I have no fear but that in the fullness of time victory will rest with these United States and the world will be a better and a happier place for those who come after us, and I further say that we cannot successfully fight labor and Germany; and if we must do both, then are we doomed to terrible defeat.

To sum up briefly the foregoing, the Navy is splendidly taking care of its needs. The opportunity should be seized to urge upon the President the selection and appointment upon the Council of National Defense of a representative shipbuilder, the committee of shipbuilders organized to work with the Emergency Fleet Corporation should be met in the fullest spirit of co-operation, and, last, and far the most important, a national campaign of personal education should be immediately undertaken to get labor in line for the ending of the war.

First Keel Laid at Newark Bay Yard

John Hunter, Representative of Shipping Board, Drives First Rivet in Keel of First Fabricated Steel Ship Laid Down at Newark Bay Plant

ON December 20, John Hunter, representing the Shipping Board, drove the first rivet in the keel of the first 5,000-ton fabricated steel ship to be laid down at the new Government shipyard erected on Newark Bay by the Submarine Boat Corporation, of New York, acting as agent for the United States Shipping Board Emergency Fleet Corporation. This marks the beginning of a tremendous drive for the rapid production of ship tonnage, upon which depends the effectiveness of the United States in the war.

The yard is located at Port Newark Terminal, fifteen minutes distant from the heart of the city of Newark, on Newark Bay, and comprises 125 acres of land which is ideally situated for a shipyard. The land has a frontage of one-half mile on Newark Bay, where the shipyard is built. Twenty-eight shipways are now under construction. A number are already completed. On the south end of the property, docks are built where the ships, when launched, will be moored while they are being fitted out with the propelling apparatus, including turbines, boilers, deck machinery, etc.

Characteristic of American energy and ingenuity, this enormously large yard was over 90 percent completed in seventy-six days and marks the completion of one of the largest shipbuilding plants in the world.

Equipment of the Yard

This yard is, in reality, an assembly point which will be fed by over forty-six steel fabricating ships accustomed to manufacturing steel material for skyscrapers, bridges, gas plants, etc. The number of workmen required on the hull construction alone, when the plant is going at full capacity, will be over 15,000, while the number of workmen in different locations from the Atlantic Coast to as far west as Milwaukee in fabricating of the raw material will represent over 30,000. The Newark Bay Shipyard will be the main assembly point for hull material, as well as turbines, deck machinery, etc., that goes to complete the entire ship. Over 15 miles of industrial standard gage railroad tracks will be laid on the property and over 30,000 piles will be driven to complete the shipways. The main buildings are of steel, two 700 feet long; the administration building of 40,000 square feet already occupied by over 400 employees. The other steel buildings, comprising machine shops, storage warehouses, equipment shops, etc., are rapidly nearing completion.

The workmen for erecting the ships will come from all parts of the country and will comprise trades which heretofore have been utilized in office building and bridge construction. Schools will be established at the plant for training these men in ship work, and it is expected that men accustomed to structural steel erection can very soon become, by the methods employed at the Newark Bay Shipyard, skilled in steel shipbuilding.

Housing of the Workmen

The housing conditions at Newark have been a problem that the shipyard has had to contend with, but through the Board of Trade of the City of Newark, and the Emergency Fleet Corporation of Washington, additional housing facilities will be afforded in the near future to take care of the great number of new men who will be called upon to work at this plant. While the demand for new houses is of the greatest importance in connection with the Newark Bay Shipyard, temporarily the cities of Newark, Jersey City and New York can take care of the large number of men who will be employed, as within a circle of ten miles of the plant over 7,000,000 people reside, making this location one of the most ideal for this enterprise.

The 5,000-ton ship which the Submarine Boat Corporation will build at this yard has been designed and worked out so that structural steel can be utilized in its construction yet equalling in every way the highest standard of shipbuilding, and the ships when completed will carry the highest classification from both English Lloyd's and the American Bureau of Shipping.

The Shipbuilding Programme

The programme is for this yard to complete 150 of these ships in the shortest possible time. Three keels were laid in December, additional ones in January and each one thereafter, it being possible to lay twenty-eight keels and have twenty-eight ships under construction at one time in this yard. With these unparalleled building facilities the progress to completion will be hastened.

It is estimated that over one thousand cities and towns of the country will be directly or indirectly interested in supplying material, labor and equipment for the vessels that will be constructed at the Newark Bay shipyard, and the assistance that can be rendered by the individuals working on this big task will be felt from one end of the country to the other.

Shallow Draft Motorships for Use on the Volga River Designed by American Naval Architect for Russian Owners

Oil Tankers of 3,500 Tons Deadweight Carrying Capacity and Cargo Boats of 1,500 Tons Capacity Limited to 7 Feet and 5 Feet Draft Respectively

THE firm of Nobel Brothers Company, Petrograd, Russia, are building, from plans furnished by J. Murray Watts, naval architect, of Philadelphia, a fleet of oil tankers for use on the river Volga. As the Nobel Brothers Company has its own shipyards and its own factories are constructing the Nobel-Diesel engines, it is unusually well equipped for the construction of steel vessels of this type.

The great difficulty of navigation on the river Volga is the fact that during periods of low water the deepest draft vessels that can be utilized in certain reaches of the river is limited to 7 feet. The interesting problem, therefore, arose of designing self-propelled steel vessels of large capacity, with this light draft, that would have a speed when loaded of 12 miles per hour.

Oil Tankers

The general dimensions are: length, 432 feet; beam, 64 feet; depth, 14 feet, and load draft, 7 feet. The vessels are constructed of mild steel. The oil cargo is carried in bulk in the deep double bottom and expansion trunk. There are four main propelling engines of the Nobel-Diesel type, each of 750 horsepower, and each driving a three-bladed bronze propeller 80 inches in diameter and 80-inch pitch, at a rate of 225 revolutions per minute, giving a speed of 12 miles loaded and about 14 miles light. There are three rudders hung outboard, actuated by a Dake steering engine aft, and controlled from the pilot house forward.

Besides the 3,500 tons of cargo in the shape of petroleum in bulk, there are tanks for the main engines and auxiliary engines.

In addition to the oil hatches leading into the expansion trunk amidships, there are two rows of hatches on either side, opening into the space above the oil-carrying double bottom. This space is used for miscellaneous cargo. The vessels will run from the oil fields up the Volga River to various discharging stations and oil refineries, making a run of about 1,500 miles. On the return trip the cargo oil tanks will be empty and the hold space above these tanks will be utilized for miscellaneous freight.

These vessels are equipped with six king posts, three on each side, and cargo booms handled by oil engine driven winches. Excellent accommodations are provided for the crew, the engineers being berthed in the deck-house aft; the navigating officers in the deck house forward, and the crew in the forecastle.

Shallow-Draft Freighters

The Nobel Brothers Company also awarded to the same designer the contract for the drawings and specifications for a fleet of cargo boats of even less draft than the oil tankers, which can navigate the shallow tributaries of the Volga. These vessels carry oil in barrels in a large

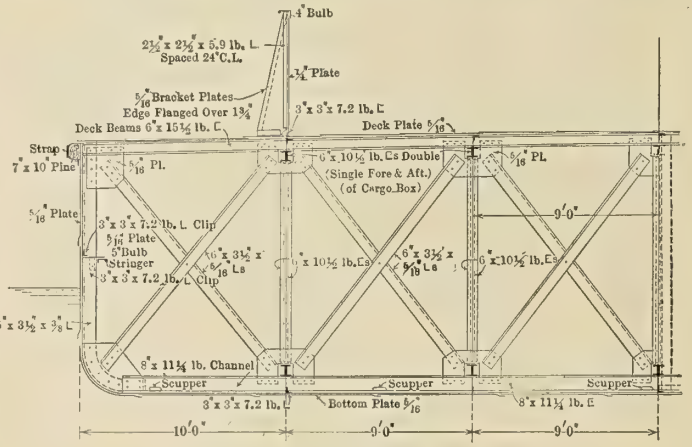

4" Bulb
2½" x 2½" x 5.9 lb. L Spaced 24" C.L.
¾" Plate
5/16" Bracket Plates Edge Flanged Over 1¾"
3" x 3" x 7.2 lb. L
Deck Beams 6" x 15½ lb. I
Deck Plate 5/16"
Strap 7" x 10" Plate
5/16" Pl.
6" x 10½ lb. Is Double (Single Fore & Aft.) (of Cargo Box)
5/16" PL.
5/16" Plate
3" x 3" x 7.2 lb. L Clip
9'0"
5/16" Plate
5" Bulb Stringer
3" x 3" x 7.2 lb. L Clip
6" x 3½" x 5/16" Ls
6" x 10½ lb. Is
6" x 3½" x 5/16" Ls
6" x 10½ lb. Is
5" x 3½" x 3/8" L
8" x 11¼ lb. Channel
Scupper
Scupper
Scupper
3" x 3" x 7.2 lb.
Bottom Plate 5/16"
8" x 11¼ lb. I
10'0"
9'0"
9'0"

Fig. 2.—Midship Section of Freighter

cargo box on the main deck. The oil is brought from the oil fields to the main distributing centers on the trip up river, and lumber and other bulk cargoes are loaded into the cargo box for the return trip.

The boats of this class are 325 feet long, and on account of the shoalness of the upper Volga River are re-

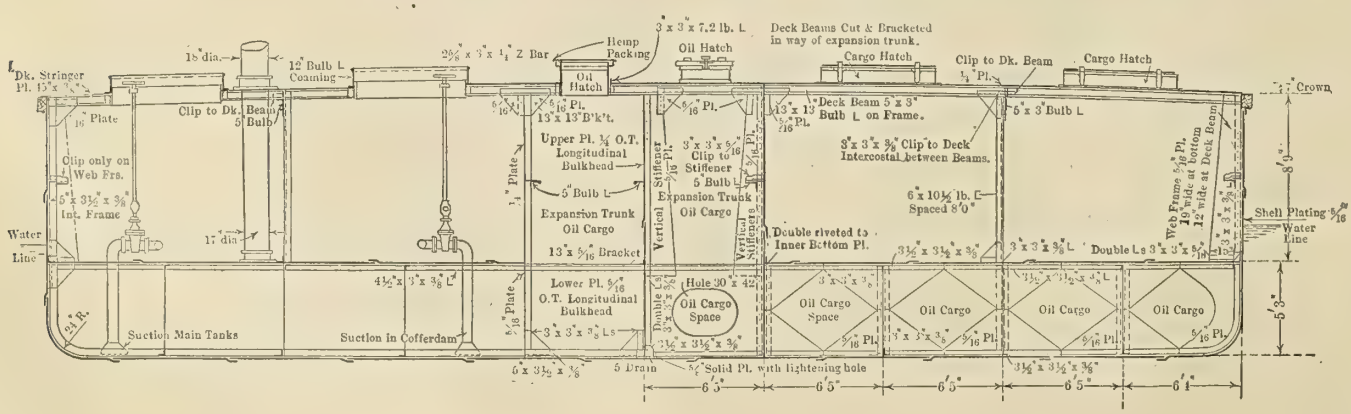

Dk. Stringer Pl. 15" x
15" dia.
12" Bulb L Coaming
2⅝" x 3" x ¼" Z Bar
Hemp Packing
3" x 3" x 7.2 lb. L
Oil Hatch
Deck Beams Cut & Bracketed in way of expansion trunk.
Cargo Hatch
Clip to Dk. Beam
Cargo Hatch
Crown
Plate
Clip to Dk. Beam 5" Bulb
Oil Hatch
5/16" Pl. 13" x 13" B'k't.
5/16" Pl.
13" x 12" Deck Beam 5" x 3" Bulb L on Frame.
5/16" Pl.
5" x 3" Bulb L
Upper Pl. ¼ O.T. Longitudinal Bulkhead
3" x 3" x 5/16" Clip to Stiffener 5" Bulb
Stiffener Pl.
3" x 3" x 5/16" Clip to Deck Intercostal between Beams.
Clip only on Web Frs.
5" x 3½" x 3/8" Int. Frame
Expansion Trunk Oil Cargo
Expansion Trunk Oil Cargo
6" x 10½ lb. I Spaced 8'0"
8'0"
Water Line
17' dia.
13" x 5/16" Bracket
Vertical Stiffeners
Double riveted to Inner Bottom Pl.
3½" x 3½" x 3/8"
3" x 3" x 3/8" L
Double Ls 3" x 3" x 5/16"
Web Frame 5/16" Pl. 19' wide at bottom 12' wide at Deck Beam
3" x 3" x 3/8"
Shell Plating 5/16"
Water Line
4½" x 3" x 3/8" L
Lower Pl. 5/16" O.T. Longitudinal Bulkhead
Hole 30" x 42"
Oil Cargo Space
Oil Cargo Space
Oil Cargo
Oil Cargo
Oil Cargo
5/16" Pl.
5/16" Pl.
5/16" Pl.
3½" x 3½" x 3/8"
6'3"
C.L.R.
Suction Main Tanks
Suction in Cofferdam
6" x 3½" x 3/8"
5" Drain
5/16" Solid Pl. with lightening hole
6'5"
6'5"
6'5"
6'5"
6'1"

Fig. 1.—Midship Section of Oil Tanker, Showing Main Scantlings

Sup

SH

SHALLOW DRAFT MOTORSHIPS FOR NOBEL BROS., PETROGRAD, RUSSIA

Designed by J. Murray Watts, Naval Architect, Philadelphia, Pa.

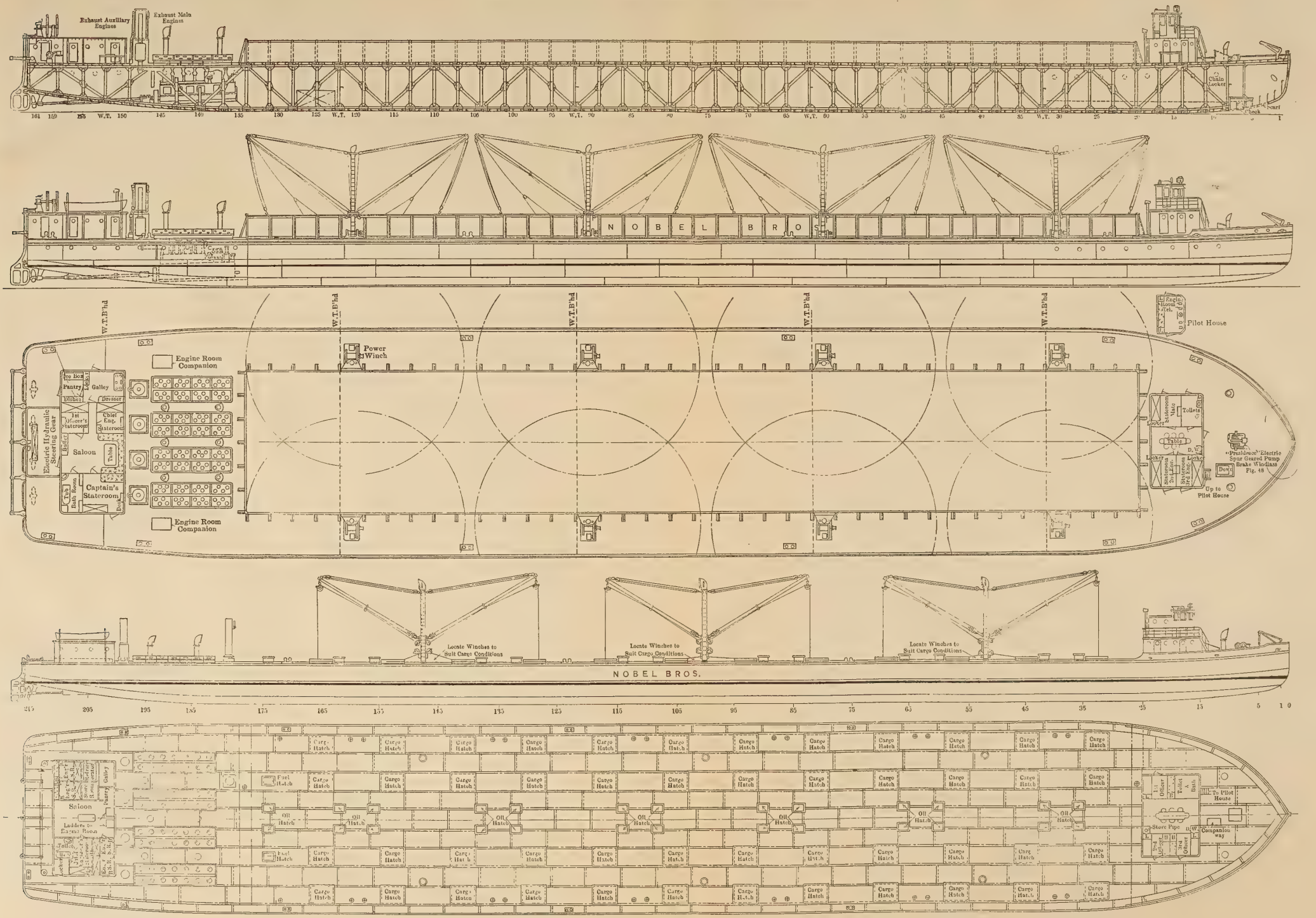


Fig. 3.—General Plans of 1,500-Ton Cargo Vessels (upper cuts), and 3,500-Ton Oil Tankers (lower cuts)

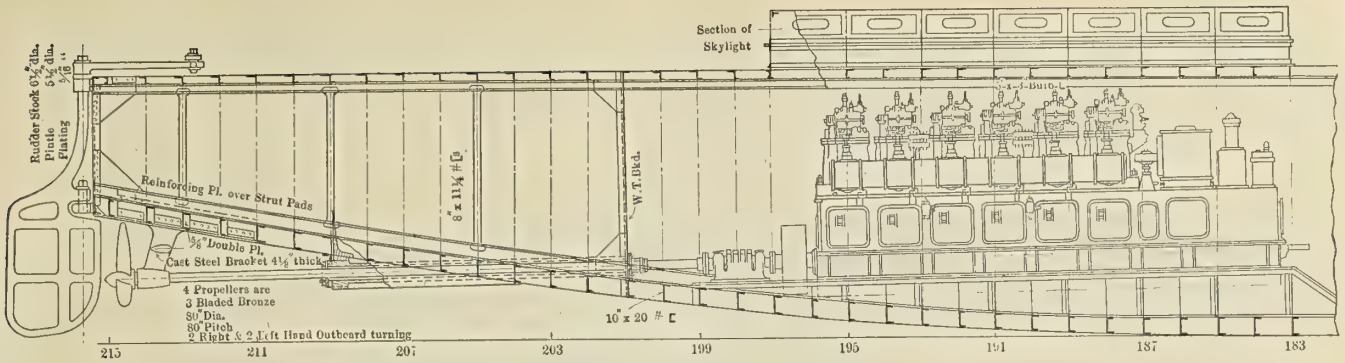


Fig. 4.—Machinery Space of Oil Tanker

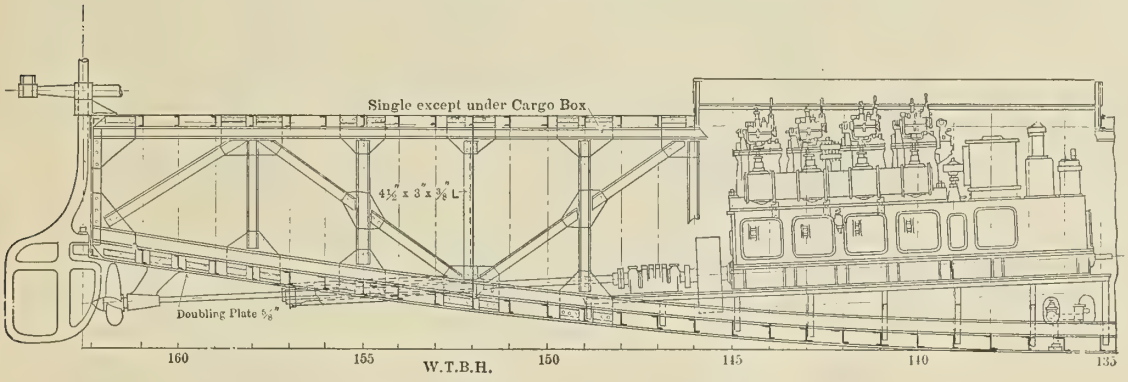


Fig. 5.—Machinery Space of Cargo Boat

stricted to 5 feet draft loaded. These vessels carry 1,500 tons of oil in barrels, besides 20 tons of fuel oil. They are quadruple screw boats driven by four 450-horsepower Diesel engines driving propellers 58 inches diameter and 58 inches pitch, giving a speed loaded of 12 miles. To handle the cargo a complete outfit of cargo winches and derricks is fitted, there being eight king posts, four on each side, and sixteen derricks. Owing to the shoalness of the boats, a very complete system of trusses is run throughout the hull, giving the necessary transverse strength against hogging and sagging strains.

Very liberal accommodations are given for the crew in the two deck houses and in the forecastle. The pilot house is up near the bows on top of the forward deck house, the arrangement being similar to the practice on the Great Lakes tankers, the steering being electrically controlled from the pilot house. To handle the boat in the sharp turns of the river, there are five rudders coupled up by a connecting rod and actuated by a hydro-electric steering system.

These boats are interesting as being the largest of their type ever designed for this shoal-draft work.

EFFECTS OF SEA WATER ON CONCRETE AND REINFORCING STEEL.—The results of an investigation by the Bureau of Standards, acting in co-operation with the Portland Cement Association, on the subject of the effect of sea water on concrete, tend to show that inferior concrete or concrete of which the surface skin has been impaired suffers serious disintegration when in contact with sea water. At the same time, doubt is expressed as to whether a thin layer of concrete can be relied upon to protect the steel reinforcement from corrosion. It is, therefore, recommended that the steel be protected by galvanization and by increasing the efficiency of the protected concrete by means of additional care in materials and workmanship and by a surface coating of waterproofing character.

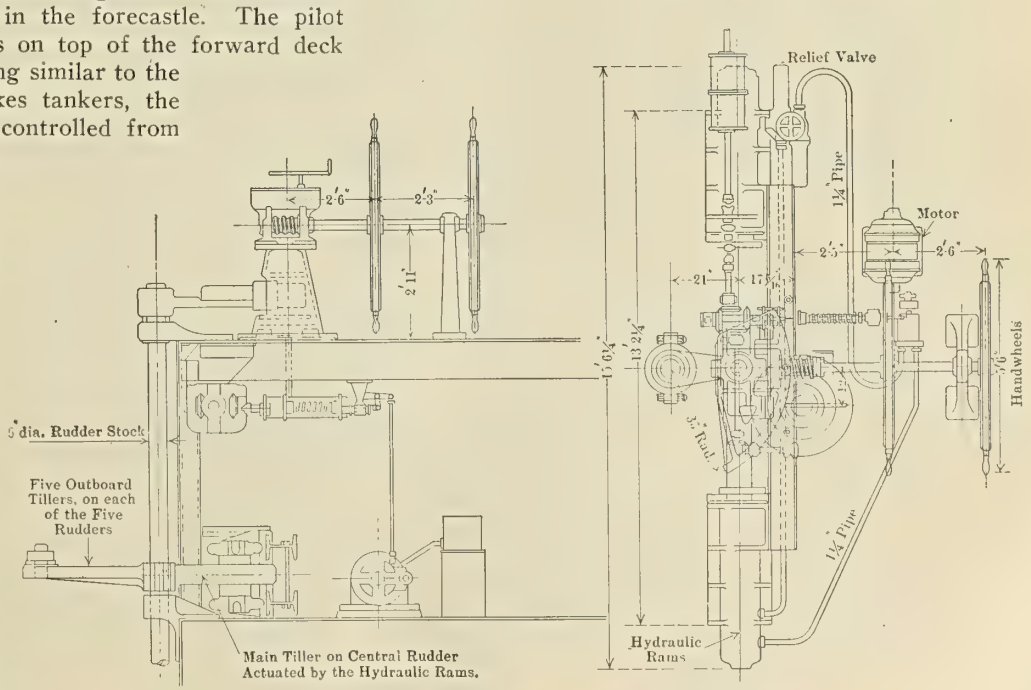


Fig. 6.—General Arrangement of Electro Hydraulic Steerer

5,000-TON REINFORCED CONCRETE SHIP

Building by San Francisco Ship Building Company

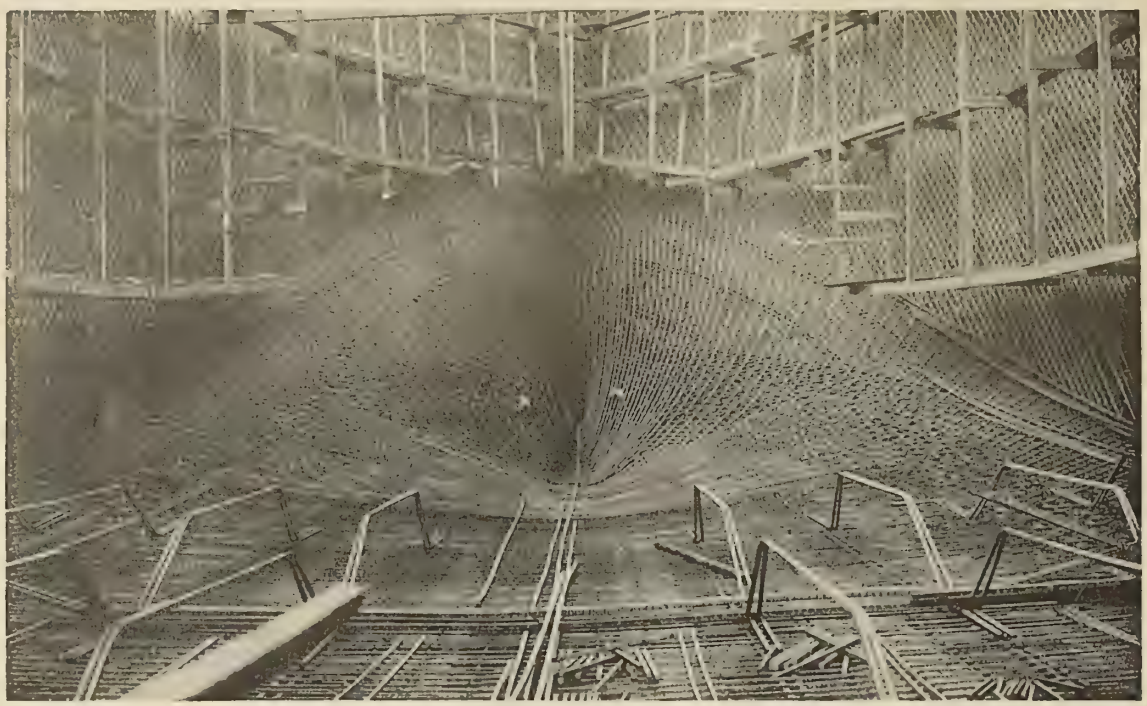


Fig. 1.—Interior View at Bow

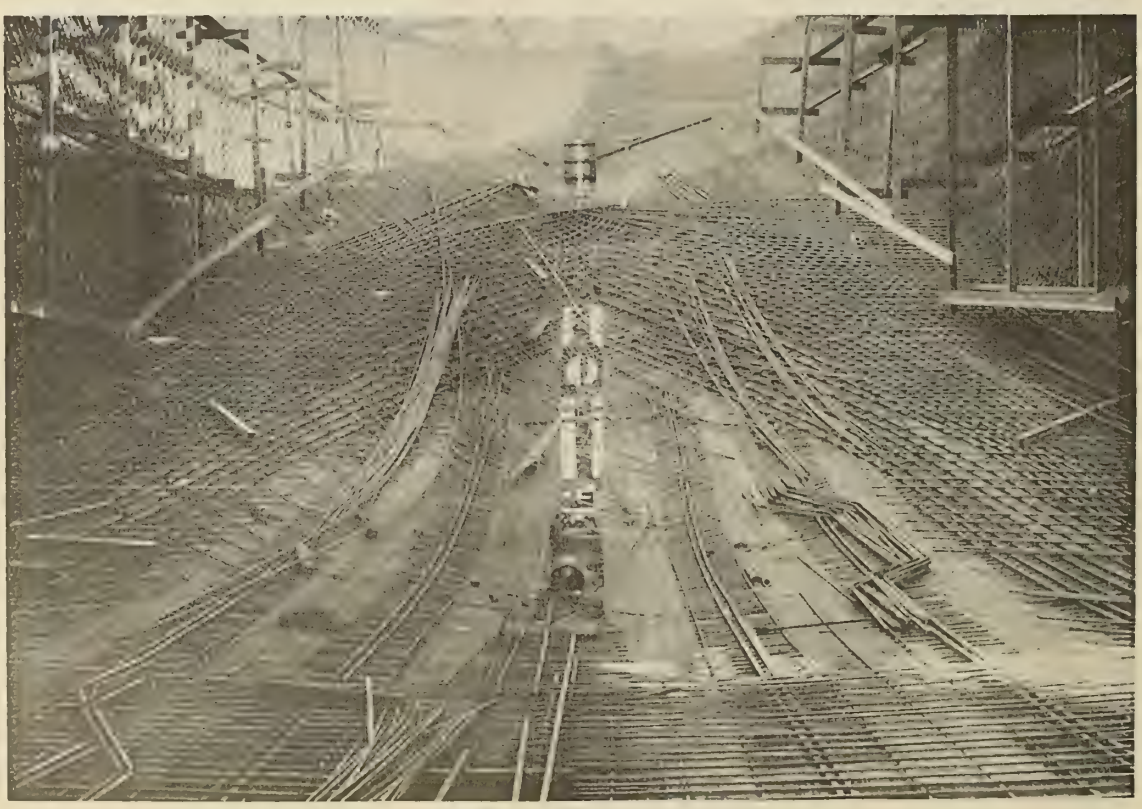


Fig. 2.—Interior View at Stern

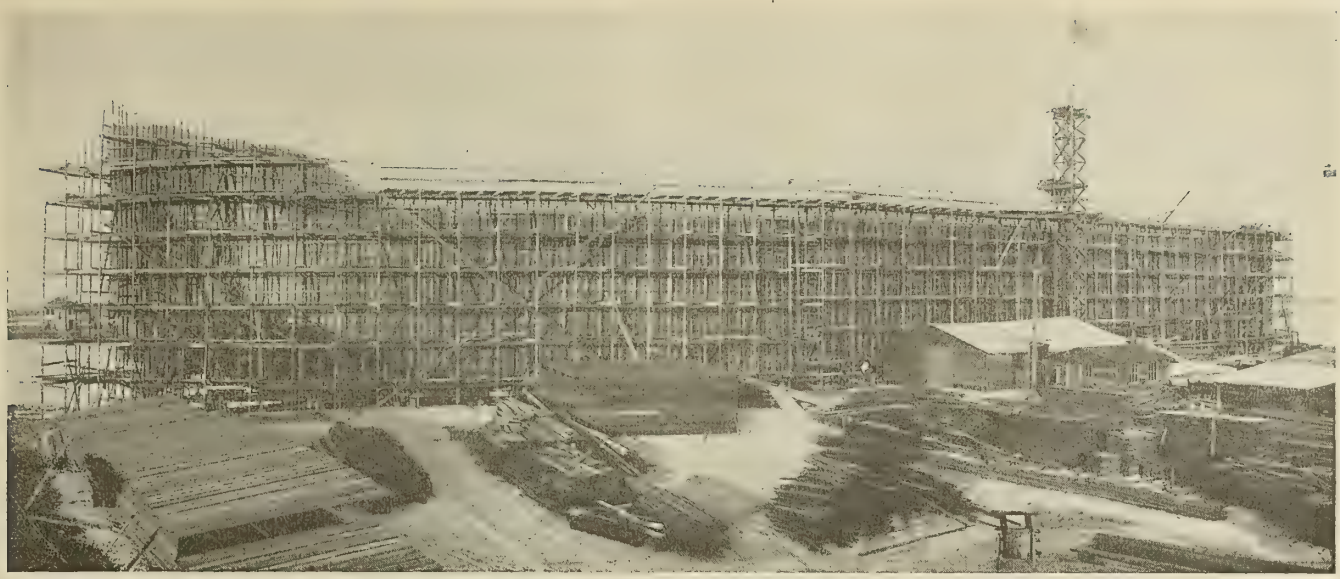


Fig. 3.—5,000-Ton Reinforced Concrete Vessel Under Construction at Redwood City, Cal.

5,000-Ton Reinforced Concrete Ship Building in California

ONE of the most daring experiments in concrete shipbuilding is the project now under way at Redwood City, Cal., where the San Francisco Ship Building Company is building a reinforced concrete freight steamship of 5,000 tons deadweight carrying capacity on a draft of 24 feet. The vessel is 320 feet long, 45 feet beam and 31 feet depth molded. She will be fitted with Scotch boilers and a triple expansion reciprocating engine of 1,750 horsepower designed to give the vessel a speed of 10 knots at sea. Tank storage space for fuel oil will be provided sufficient for thirty days' steaming at her designed speed.

Some idea of the size and details of construction of the vessel can be gained from the photographs reproduced herewith, which show the progress of construction about December 1. The officers of the San Francisco Ship Building Company, which is building the vessel, are: President, W. Leslie Comyn; vice-president, John Lawson, of Balfour, Guthrie & Co.; secretary, Kenneth MacDonald, of MacDonald & Kahn, and treasurer, George U. Hind. Messrs. Leslie Comyn and John Lawson, acting as an executive committee, exercise active management of the affairs of the company.

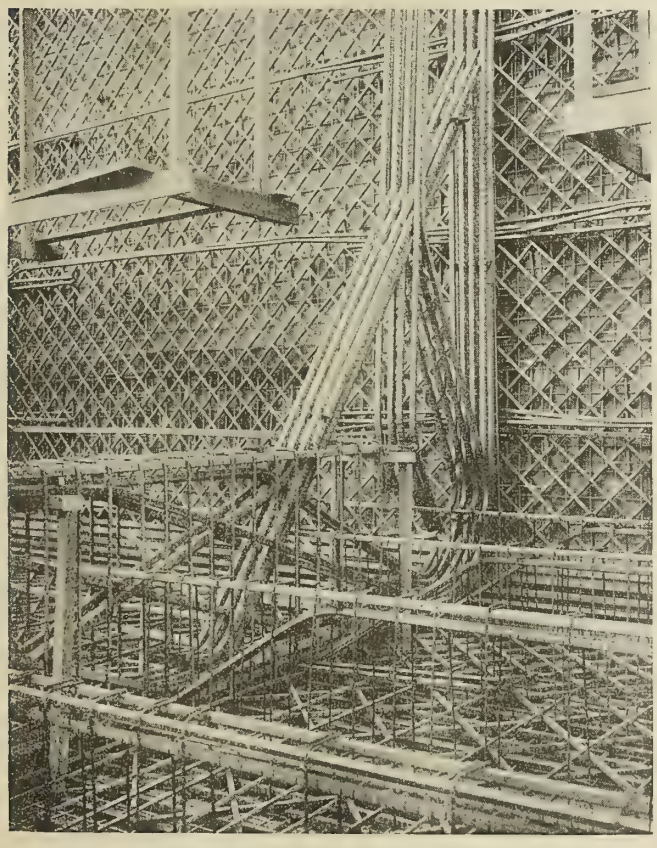


Fig. 4.—Reinforcement of Hull

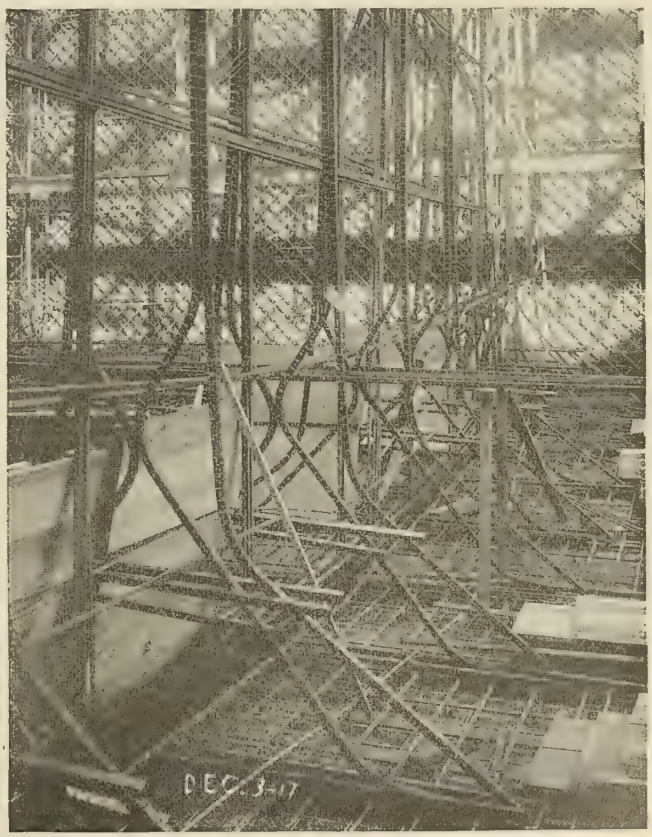


Fig. 5.—Arrangement of Reinforcing Rods

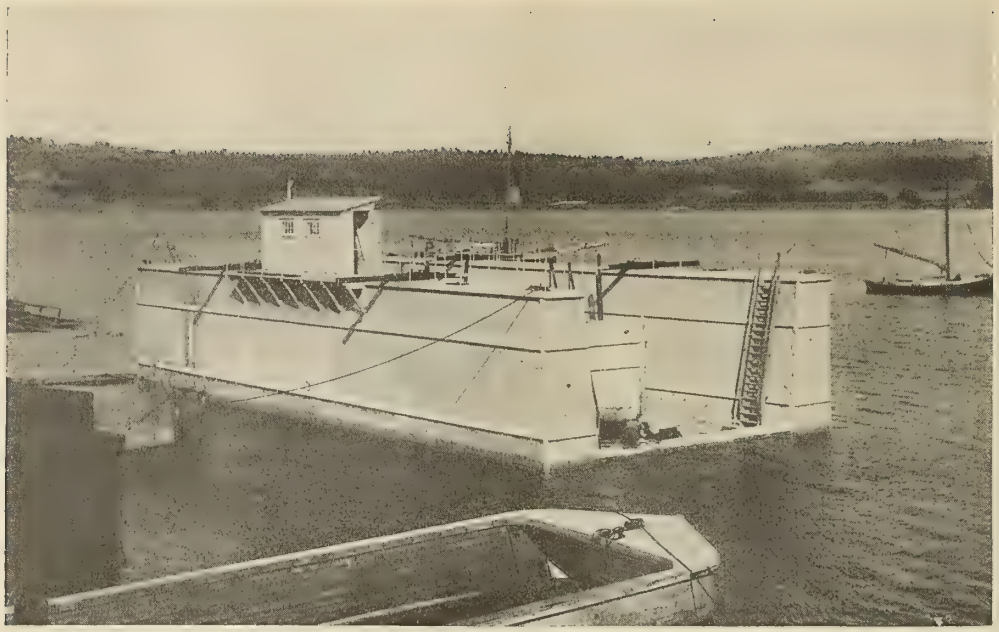


Fig. 1.—Concrete Floating Dry Dock with Concrete Lighter on Board

Ferro-Concrete Shipbuilding in Norway

Descriptions of Vessels Built by the Fougner Steel-Concrete Shipbuilding Company, of Christiania— Standardized Motorships of 360, 1,000 and 1,600 Tons

BY ROBERT G. SKERRETT

TO the Norwegians belongs the credit of having first produced a ferro-concrete, motor-driven, seagoing freighter. The *Namsenfjord,* for such is the name of the craft, is now actively engaged in coastwise traffic in Scandinavian waters, and reports from abroad disclose that she is in every way a satisfactory cargo-carrier within the limits of her displacement. Her deadweight capacity is 200 tons, and her propelling power is centered in a single 80-brake horsepower Bolinder oil engine. This suffices to drive her light at a speed of 8½ knots, or full laden at the rate of 7½ knots. The success of the *Namsenfjord* has blazed the way for a large business in granolithic motor-driven cargo vessels for her builders, the Fougner Steel-Concrete Shipbuilding Company, of Christiania, Norway. But, properly speaking, the *Namsenfjord* represents a distinct climax in naval architecture which had its beginning in a flotilla of lighters of reinforced concrete.

The managing director of the company, Engineer Nic. K. Fougner, is now in this country arranging for the establishment of a shipyard here, and because of this fact his achievements in Norway are of just so much more present interest to us. We say his achievements because the success of the building plant at Moss is undeniably due to his initiative and to his exceptionally broad familiarity with reinforced concrete and previous experience in the construction of a good-sized lighter built in Manila by him as an experiment some years ago. That barge was subsequently bought by a tobacco firm in the Philippine Islands, but Mr. Fougner did not dispose of it until he had subjected the craft to a series of convincing tests by

Fig. 2.—The *Namsenfjord* During Trial Trip

Fig. 3.—Ferro-Concrete Motor Tug Built by Fougner Company for Its Own Service

Fig. 4.—*Namsenfjord* Before Launching

which he demonstrated the correctness of his principles of construction, as well as the strength and sturdiness of the vessel.

Returning from the Far East just when Norway was beginning to feel the pinch of a shortage of structural steel for shipbuilding, he saw at once how his past work could be turned to good account, and lost no time in urging the organization of a company equipped to undertake the building of ferro-concrete seagoing ships. Conditions were made riper for consideration of his plan by reason of the ravages of German submarines. The Norwegians were sorely in need of additional bottoms, and native shipowners were keen for any sort of craft that would serve their purpose. Accordingly, the Fougner Steel-Concrete Shipbuilding Company, with Mr. Nic. K. Fougner as president, was organized in May of 1916, with a capital of substantially $130,000 (£26,600), and this was followed immediately by the establishment of a plant at Moss. Owing to the amount of business on hand and contracts pending, it became necessary early in 1917 to expand the shipyard and to increase the working capital to something like $700,000 (£143,500)—more than five times the original investment. It is suggestive of Norwegian enterprise and business acumen that the issue of stock in both instances was largely oversubscribed, and the biggest banking concern in the country stood squarely back of the enterprise. During the six months of actual production in 1916 the company paid a dividend of 10 percent to its shareholders.

The first work undertaken consisted of orders for a number of steel-concrete lighters of 100 tons capacity; then followed the construction of a floating dock of reinforced concrete having a lifting capacity of 75 tons. This dock was built for a firm of yacht builders in Christiania, and has proved efficient and satisfactory in every particular since being turned over for service. While comparatively small as floating drydocks go, it established the practicability of using ferro-concrete in that department of marine activities. Other docks are in course of construction and plans for two, each capable of handling craft of 7,000 tons, have just been finished.

Next, the *Namsenfjord* was started. The time taken to turn her out was somewhat longer than at first contemplated, because Mr. Fougner felt that he had taken a big step forward and wanted to be sure that he was right

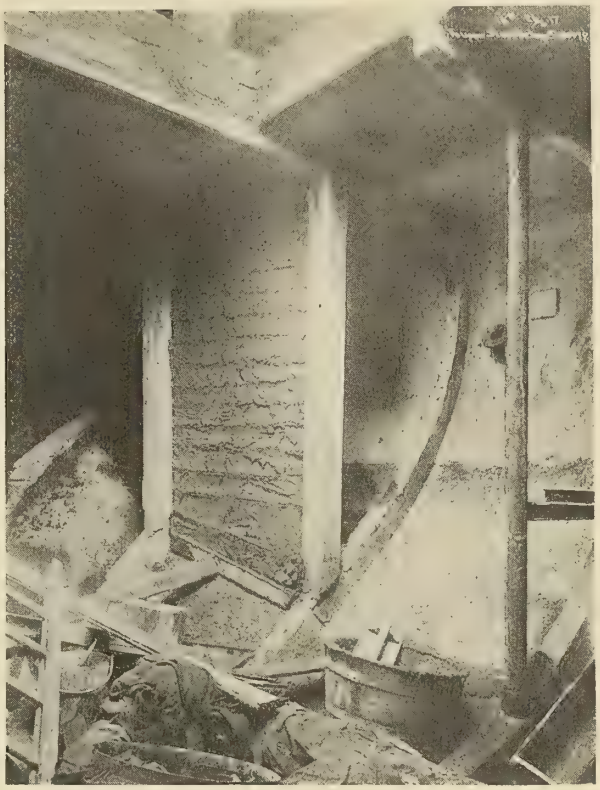


Fig. 6.—Interior of *Namsenfjord* During Construction, Showing First Wall of Side Water Tank

Fig. 5.—Interior of Hold

in every essential. His method of construction differs radically from those urged or generally adopted by others engaged in naval architecture of this special class. As was the case with his lighter in Manila, his aim is to reduce the measure of steel material to a minimum and to use the very simplest of these—such as wire mesh, steel lath and bar stuff, all of which are comparatively easy to get, and call for only a very common class of labor to bend or form to suit the needs of any type of floating structure. In this way, steel plates, angles, etc., bent to shape and requiring riveting are entirely dispensed with.

The wire mesh or steel lath are not intended to reinforce the granolithic mass—the bars alone do this—but the fabricated stuffs, any of which can be employed, merely serve as the two walls between which is cast the principal mass or shell of the craft. Because the wire mesh or the steel lath, as the case may be, is porous, enough of the concrete exudes to form knobs or lumps upon the two outer sur-

faces of the so-called mold walls. These projections provide keys, so to speak, for the finished exterior skin and the interior surfacing of the vessel. The deck beams and frames are stiffened by bar iron or steel ranging in thickness from a quarter of an inch to an inch and a quarter, and these are tied or linked to one another by hooked terminals. Deck stanchions, for convenience' sake, are made of piping filled with cement. It will thus be seen that the use of molds, as such are commonly understood, is done away with.

But apart from simplicity of getup and the need of only a small amount of steel material, Mr. Fougner gains much in structural strength by producing a floating body of uniform integrity. His steel work is completely buried in the granolithic mass, and perfect union, it is claimed, is insured. He does not try to attach a veneer of concrete to a fabricated framework of steel, and, therefore, the stresses of sea service cannot induce disunion, fracture and possibly structural collapse. Because of the method adopted by him, costs are necessarily very low by comparison with other types of ferro-concrete craft, and the time to build is likewise notably shortened. He is satisfied that when his yard here is ready for operations he will be able to turn out motor-driven ships of 3,000 and 4,000 tons deadweight capacity within a period of ninety days.

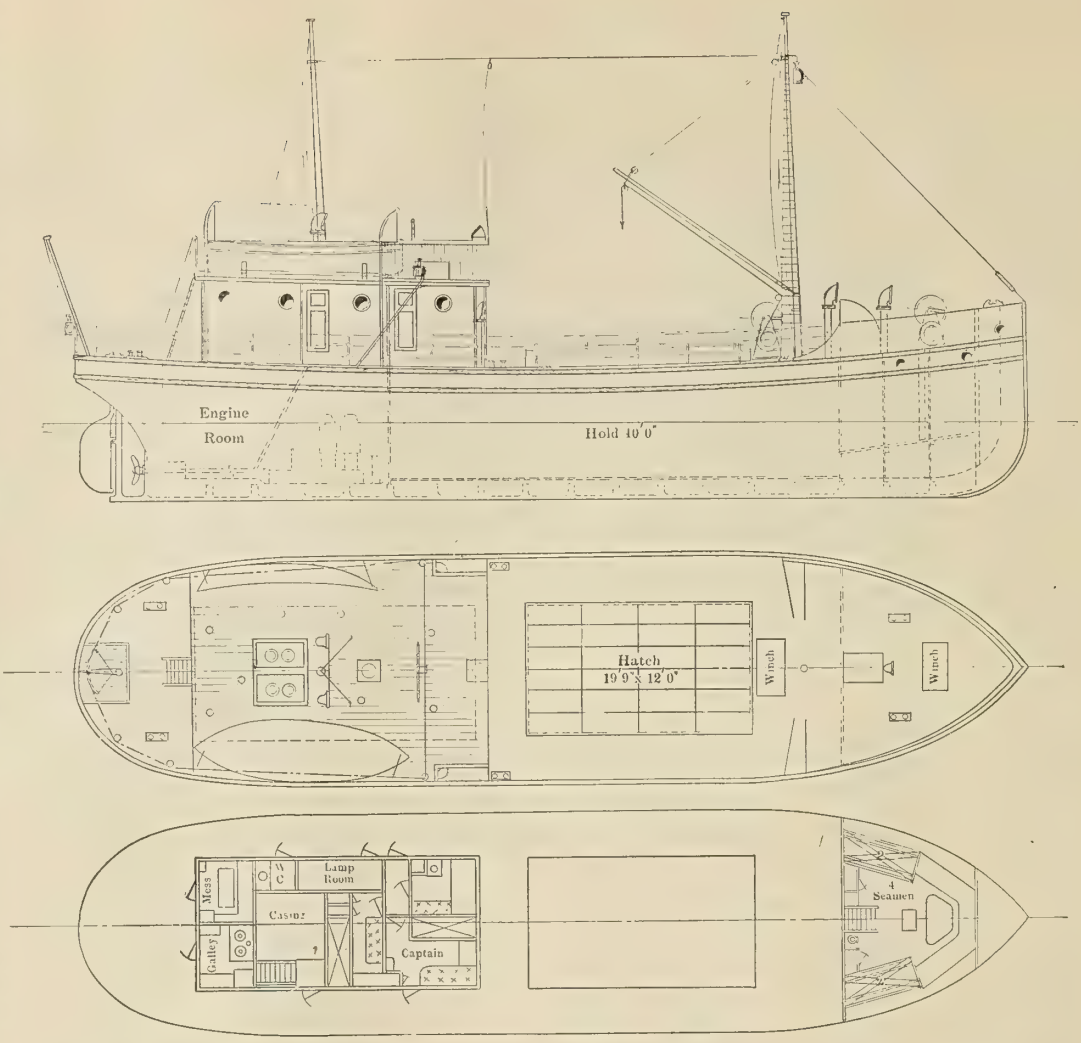


Fig. 7.—200-Ton Concrete Motorship; Length, 84 Feet; Beam, 20 Feet; Depth, 11 Feet 6 Inches

The question has repeatedly been asked, how will the concrete ship withstand the attack of salt water? And in answer we are told that it is possible to use a composition made from volcanic refuse, such as the ancient Romans did, and deposits of this stuff are to be found here in abundance. But Mr. Fougner has dealt with the problem in a more practical way: he waterproofs his concrete. For this purpose he has recourse to a colloidal ingredient which is added at the time of mixing the concrete. The colloid becomes an integral part of the mass, coating the surfaces of the pores left by the evaporation of the original water required in the preparation of the concrete. If moisture or water subsequently seek to penetrate, the colloid expands the instant it is acted upon by the moisture, and automatically forms a barrier capable of effectually arresting further progress on the part of the water. In short, Mr. Fougner says the outlying water or moisture is held at bay at the very surface of the mass. Therefore, the sea does not induce disintegration through the bursting stresses set up within concrete where sea water is brought in contact with cement containing free lime. To prevent the accumulation of marine growths, Mr. Fougner recommends the coating of the under-water surfaces with any suitable anti-fouling paint. He has found that these will adhere perfectly, and, in this way, wetted surfaces of low skin friction can be assured.

In the *Namsenfjord* the hull walls vary in thickness from 4 inches to 2½ inches—the latter being above water and along the bulwarks, while the heavier sections are naturally submerged and in the neighborhood of the bilges and bottom. This is in decided contrast with practice elsewhere in ferro-concrete construction. The *Namsenfjord* has longitudinals or inboard keelsons, and these are multiplied immediately beneath the oil engine foundation. Over here, it is Mr. Fougner's intention to employ the cement gun for the external coatings of the wire mesh or steel laths, but the final outside finish will be obtained by handwork.

Speaking of the engagements of his concern in Norway, he has lately announced: "Owing to the great demand for tonnage, our company has decided to standardize its output by centering upon motor-driven types of 360 tons, 1,000 tons and 1,600 tons. Aside from these, the yard at Moss has contracted for an ore-carrying ship of 4,000 tons, provided with twin screws actuated by large Diesel motors. The first of our 1,000-ton ships is to be launched

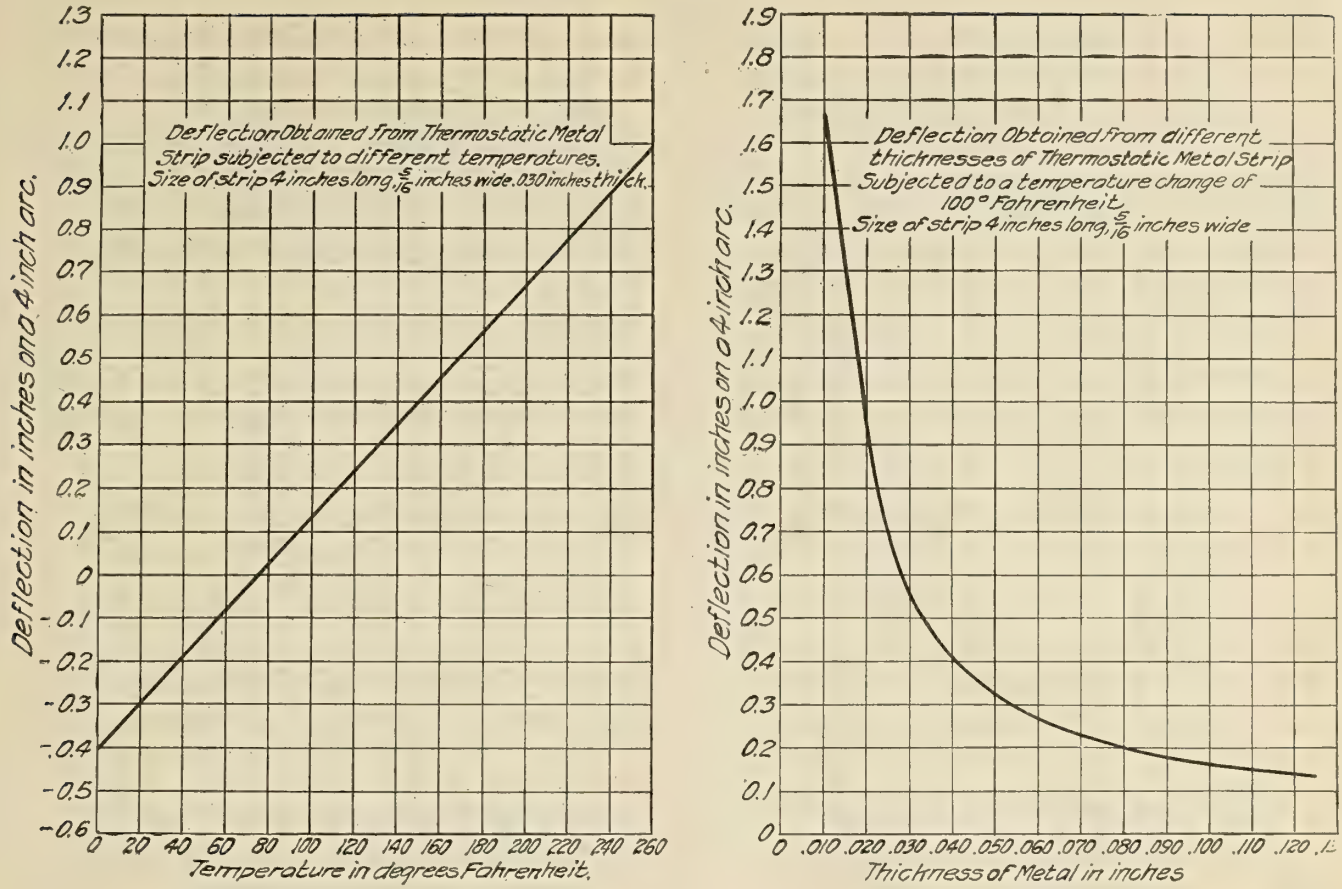

Deflection Obtained from Thermostatic Metal Strip subjected to different temperatures. Size of strip 4 inches long, 5/16 inches wide .030 inches thick.
Deflection in inches on a 4 inch arc.
Temperature in degrees Fahrenheit.
Deflection Obtained from different thicknesses of Thermostatic Metal Strip Subjected to a temperature change of 100° Fahrenheit. Size of strip 4 inches long, 5/16 inches wide
Deflection in inches on a 4 inch arc.
Thickness of Metal in inches

Fig. 1

this month (December), and the initial craft of 1,600 tons should be put overboard in January. I am satisfied that one of our bigger boats will cross the Atlantic in the course of the coming spring." In all, the Fougner firm has built or nearly finished a total of 20 vessels, and among this output is a lightship for the Norwegian government.

The British authorities have been keenly interested in the activities of the Moss plant, and the English government and Lloyds sent a commission to Norway to examine and to report upon the concrete vessels turned out by the Fougner Company. As a result, the *Namsenfjord* was given an official rating by Lloyds of A1. Even though we may hesitate to embark upon the building of ferro-concrete ships for transatlantic service, it is evident that enough has already been established by the *Namsenfjord* to show the practicability of craft of this sort for coastwise service and for duty upon our rivers and Great Lakes. We are desperately in need of bottoms of all sorts for domestic trade and water-borne transportation within continental limits. The scarcity of structural steel shapes and plates makes it apparent that the granolithic vessel may prove the readiest solution of the problem. We need bottoms that can be delivered quickly, and the shipowner wants boats that will endure; will cost as little as possible to maintain or repair; that will be fireproof, and which can be counted upon for rugged service.

DESIGN FOR CONCRETE SHIP.—In a recent report made by a joint committee from the American Concrete Institute and the Portland Cement Association, is given the design for a 2,000-ton self-propelled barge, 227 feet 6 inches long, 42 feet beam, of 3,675 tons displacement at a load draft of 18 feet. It is stated that the total cost of hull, exclusive of equipment, would be $126,000, or about $63 per ton deadweight.

Thermostatic Metal Developed by General Electric Company to Control Appliances by Heat or Cold Applicable to Marine Work

The development of the G. E. thermostatic metal by the General Electric Company, Schenectady, N. Y., has put a new means for warning of undue heat or cold and prompt regulation of the temperature changes into the hands of naval architects, naval constructors and navigators.

This metal is so susceptible to temperature changes that, according to the manufacturers, a difference of one degree higher or lower will tend to curve or straighten it and always to the same extent. It can be used for temperatures as high as 500 degrees F. By curvature or

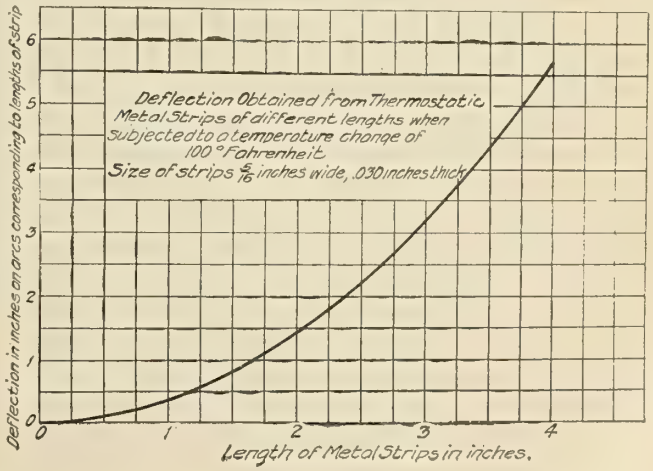

Deflection Obtained from Thermostatic Metal Strips of different lengths when subjected to a temperature change of 100° Fahrenheit. Size of strips 5/16 inches wide, .030 inches thick.
Deflection in inches on arcs corresponding to lengths of strip
Length of Metal Strips in inches.

Fig. 2

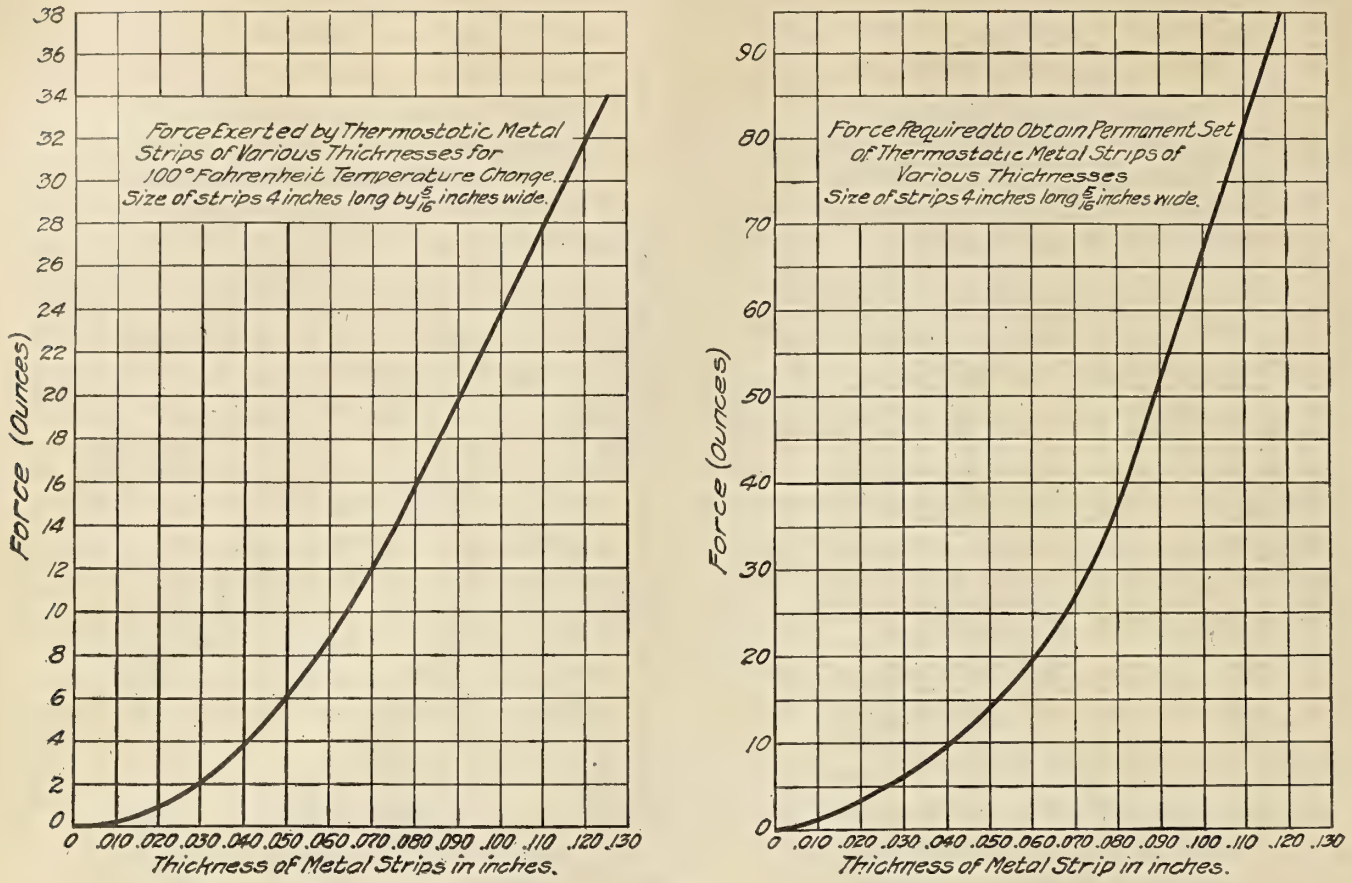

Force Exerted by Thermostatic Metal Strips of Various Thicknesses for 100° Fahrenheit Temperature Change. Size of strips 4 inches long by 5/16 inches wide.
Force (Ounces)
Thickness of Metal Strips in inches.
Force Required to Obtain Permanent Set of Thermostatic Metal Strips of Various Thicknesses Size of strips 4 inches long 5/16 inches wide.
Force (Ounces)
Thickness of Metal Strip in inches.

Fig. 3

straightening it will make and break electrical contacts and even exert a force.

Its present use as a means of temperature regulation in furnaces and refrigerators, together with its non-corrosive characteristics, suggests its possibilities in marine service. As a result of its responsiveness to change of temperature and the mechanical force developed, this metal is used to actuate various mechanisms which tend to neutralize either the temperature change or its effect upon devices.

G-E thermostatic metal consists of two strong non-corrosive metals possessing a wide difference in coefficients of expansion, the widest difference possible for any known stable combination of metals. These two metals are firmly attached to each other throughout their entire length, so that there is absolutely no slip of the one upon the other. Thermostatic metal can be cut, stamped or pressed into practically any shape, and when annealed will have all its original inherent qualities; moreover, it will not deteriorate nor take permanent set under applications of heat or force within definite practical limits. The metal is manufactured in various standard thicknesses ranging from 0.25 to 0.015 inch, maximum width of 6 inches and maximum length of 36 inches.

The deflection per degree temperature change besides being quite considerable, as shown by the right-hand curve in Fig. 1, is a constant for any definite piece of the metal, as will be seen by referring to the curve in Fig. 2. Since a definite and considerable opposing force is necessary to cause the metal to take permanent set (see right-hand curve, Fig. 3), the metal can be depended upon when used in devices where extreme accuracy is required.

If the curving of thermostatic metal on heating or cooling is opposed, the metal will produce a mechanical force (see left-hand curve, Fig. 3), which is limited only by the force required to produce permanent set, right-hand curve (Fig. 3). For example, the left-hand curve (Fig. 3) shows that a piece of thermostatic metal 1/10 inch thick, 5/16 inch wide and 4 inches long will exert a force of 24 ounces (1½ pounds) on being restrained from bending when subjected to a temperature of change of 100 degrees F. This curve illustrates the law that the force by this metal varies as the square of the thickness, directly as the width and as the square of the temperature.

Other curves given illustrate the deflection resulting as one of the two dimensions, length or thickness, varies with a definite change in temperature. The width of the piece has no influence on the deflection resulting from temperature change. From these curves it will be found that the deflection for any given temperature change varies as the square of the length of the piece of thermostatic metal and inversely as the thickness of the piece. As previously pointed out, the deflection of any piece of metal varies directly as the temperature change.

G-E thermostatic metal is used in the products of many different industries, owing to the fact that it can be successfully worked into different shapes and forms. In some of its applications it is used to actuate mechanisms directly by means of the force developed within itself when its tendency toward assuming a curved shape is restrained. In other applications it is used to close and open the contacts of electrical circuits by means of which various devices are operated.

The reliability of this metal has merited its use in thermometers and has gained consideration for it as a compensating device in balances, and it is but a step forward to see it used in the proverbially accurate ship's chronometer.

Cargo Ship Lines of Simple Form

Paper Read Before Naval Architects' Society Describing Results of Tests of Models of Simplified Form at Washington

BY NAVAL CONSTRUCTOR WILLIAM MC ENTEE, U. S. N.

The recent wide discussion and general interest in possibilities of standard cargo ships to be built in large numbers from standard plans has naturally brought into prominence the matter of simplifying the form of ships.

The tendency in ship construction for a long period has been in the direction of simplification. In general, the simplification of form requires the use of plain surfaces at right angles instead of curved surfaces wherever possible. Where curvature is unavoidable, the simplest of curves, the circle, should be used. All curvature should be in one direction only; that is, surfaces of double curvature should be avoided so far as possible.

These considerations lead, in the forming of a ship, to the adoption of a midship section formed by two vertical lines and a horizontal line at the bottom, the corners or bilges being rounded off by circles of suitable radius. The sides and bottom of the ship will be flat surfaces carrying the full midship section well forward and aft, making what is known as the parallel middle body extend as far as possible without excessive increase in resistance. Forward, where it is necessary to fine the lines to form an entrance, it can be done by gradually decreasing the width of the ship, keeping the bottom flat and the sides vertical, the bilge being formed by a quarter circle of constant radius equal to that used for the middle part of the vessel.

Aft, the possibilities of simplification are limited by the necessity for providing space for the propellers. Two different methods of simplifying the after body are shown in Model 1,997 and Model 2,056, Figs. 1 and 2. The general result in these forms is to make the waterline somewhat wider and place the displacement higher up. This arrangement seems favorable from both the resistance and the propulsion standpoints, but may have disadvantages as regard seagoing qualities.

In the present investigation an attempt has been made to show how the power required for propulsion is affected by simplification of the lines of three different types of cargo vessels.

TABLE I—DIMENSIONS

Model Number.	Type.	Length, Feet.	Beam, Feet.	Draft Feet.	Displacement, Tons.	Speed, Knots.	E. H. P.	Longitudinal Coefficient.	Midship Section Coefficient.	Parallel Middle Body, Percent.
1978	Oil fuel barge, conventional form	160	25	9 25	830	6	34.4	.80	.98	30
1997	Oil fuel barge, simplified lines	160	25	9.25	850	6	35.6	.82	.98	40
2023	400-foot freighter, conventional form	400	57.3	26	13,137	10.5	1080	.788	.987	33.4
2056	400-foot freighter, simplified lines	400	57.3	26	13,137	10.5	1120	.788	.987	33.4
Series*	500-foot cargo vessel, conventional form	500	73.6	26.77	20,000	14	3440	.74	.96	30
2045	500-foot cargo vessel, simplified lines	500	72.5	26.375	20,000	14	3290	.74	.989	30
1121	U. S. Collier Neptune	520	65	27.5	19,340	14	3460	.738	.983	25

* Estimated from Experimental Model Basin's Parallel Middle Body Series (No. 26).

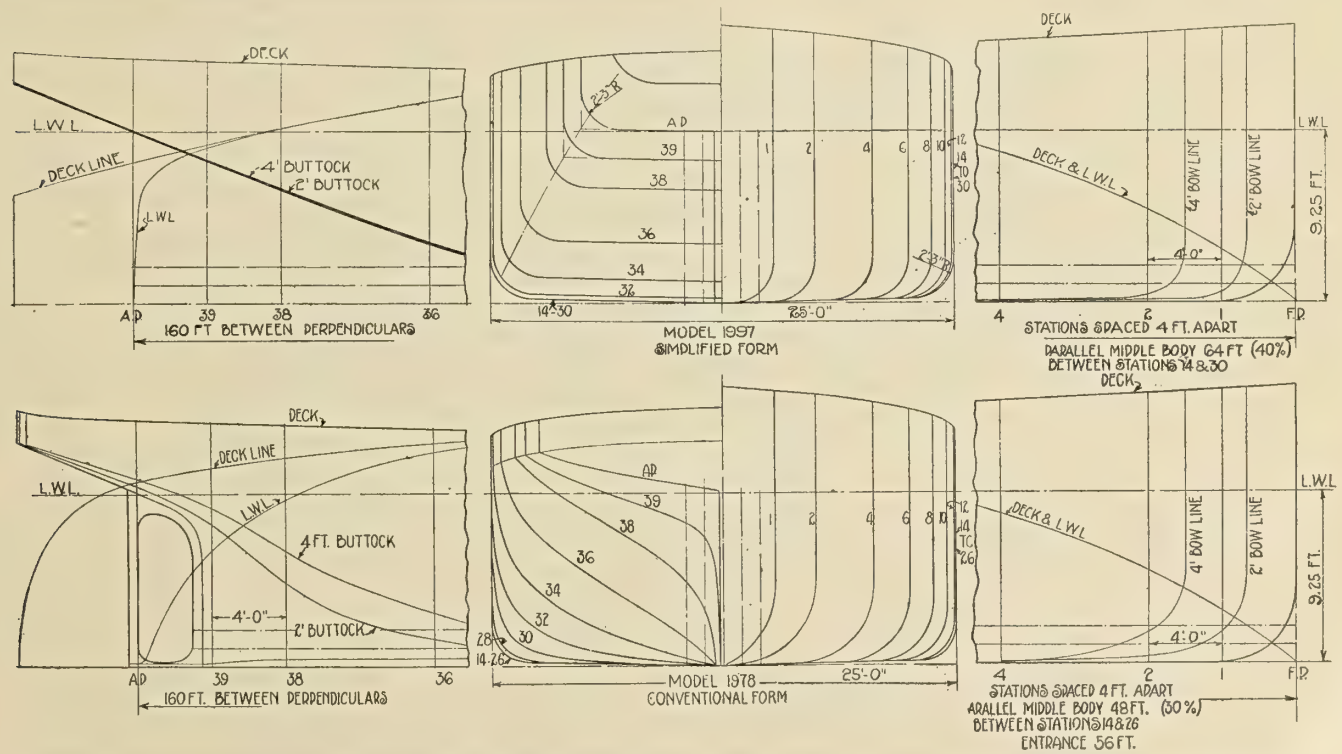


Fig. 1.—Lines of Models Nos. 1978 and 1997, Representing 160-Foot by 25-Foot by 9.25-Foot by 830-Ton Fuel Oil Barges of Conventional Form and of Simplified Lines

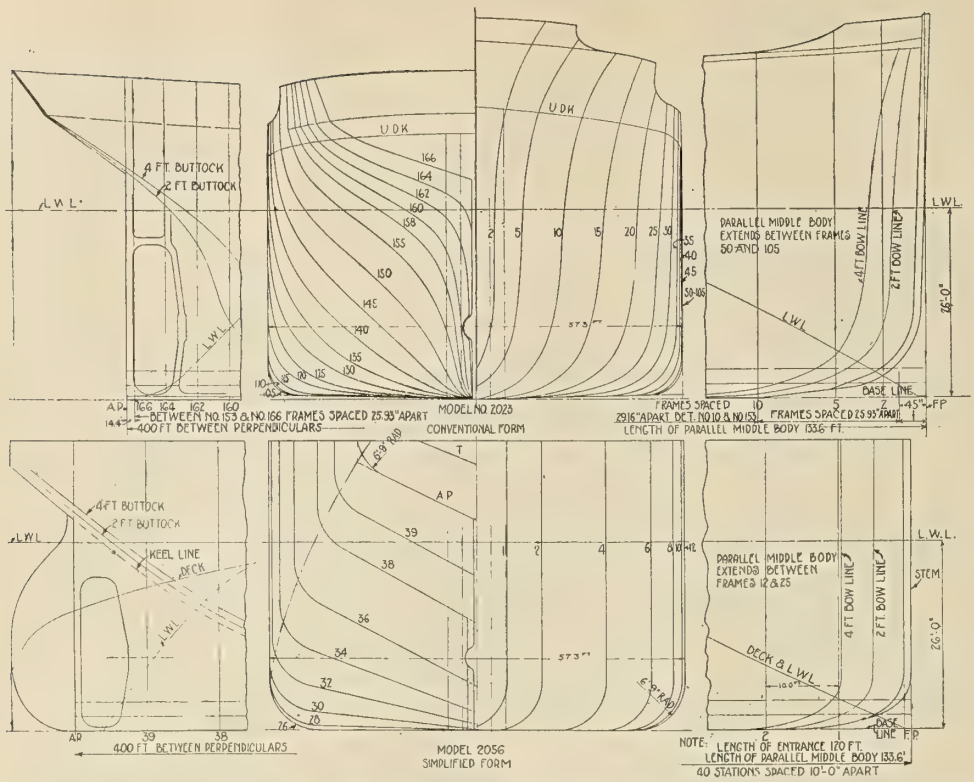


Fig. 2.—Lines of Models Nos. 2023 and 2056, Representing 400-Foot by 57.3-Foot by 26-Foot by 13,137-Ton Cargo Ships of Conventional Form and of Simplified Lines

Models 1,978 and 1,997, lines of which are shown on Fig. 1, are models of a 160-foot oil fuel barge of 830 and 850 tons, respectively. Through a slight error in making Model 1,997, the cylindrical or prismatic coefficient and displacement are somewhat larger than for the model with which it is compared; that is, No. 1,978 of conventional form. The effective horsepower curves for the estimated power are shown in Fig. 4. It will be seen that the curves are very nearly the same, the simplified form requiring about 35 effective horsepower at 6 knots, as compared with 34 for the conventional form, due to the larger cylindrical coefficient of the simplified form.

Models 2,023 and 2,056, lines of which are shown in Fig. 2, are of a 400-foot, 10.5-knot cargo ship of the usual

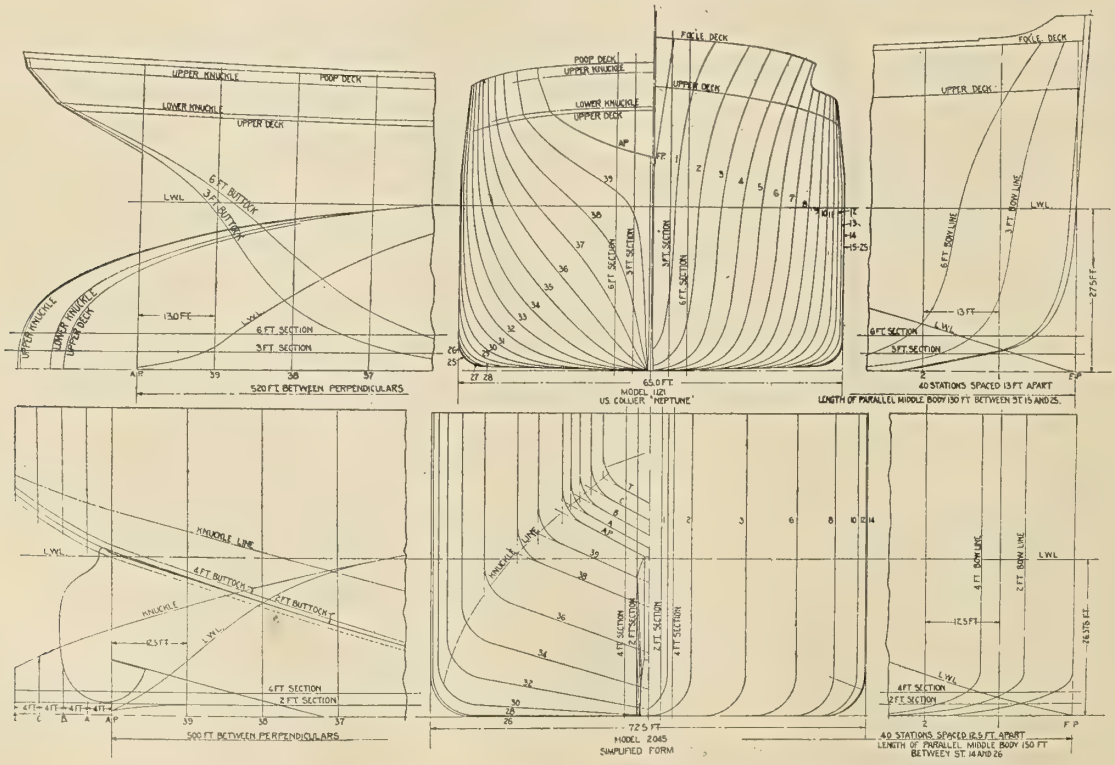


Fig. 3.—Lines of Models Nos. 2045 and 1121, Representing 500-Foot by 72.5-Foot by 27.5-Foot by 20,000-Ton Cargo Ship of Simplified Lines and 520-Foot by 27.5-Foot by 19,340-Ton Collier

LIBRARY JUL 25 1928 U.S. PATENT OFFICE

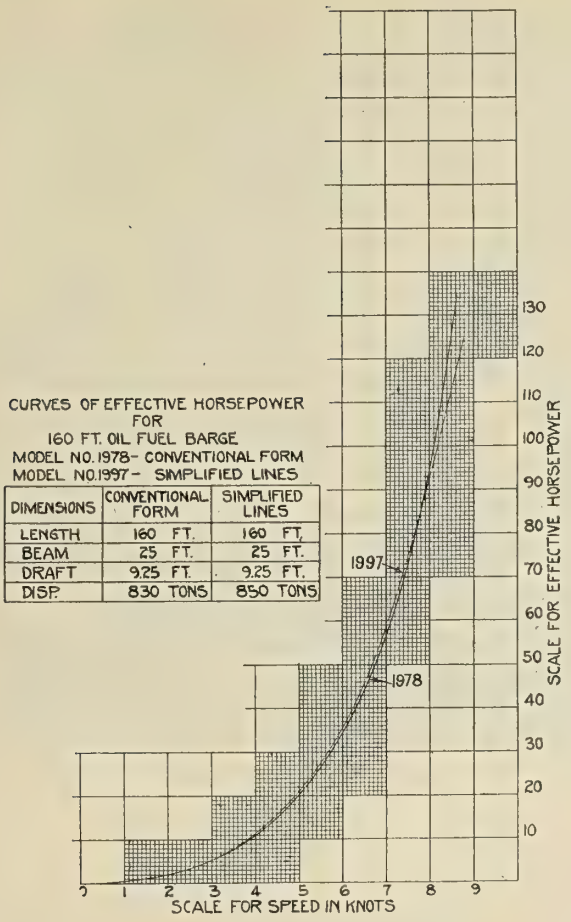

CURVES OF EFFECTIVE HORSEPOWER
FOR
160 FT. OIL FUEL BARGE
MODEL NO. 1978 - CONVENTIONAL FORM
MODEL NO. 1997 - SIMPLIFIED LINES
DIMENSIONS | CONVENTIONAL FORM | SIMPLIFIED LINES
LENGTH | 160 FT. | 160 FT.
BEAM | 25 FT. | 25 FT.
DRAFT | 9.25 FT. | 9.25 FT.
DISP. | 830 TONS | 850 TONS
1997
1978
SCALE FOR EFFECTIVE HORSEPOWER
SCALE FOR SPEED IN KNOTS

Fig. 4

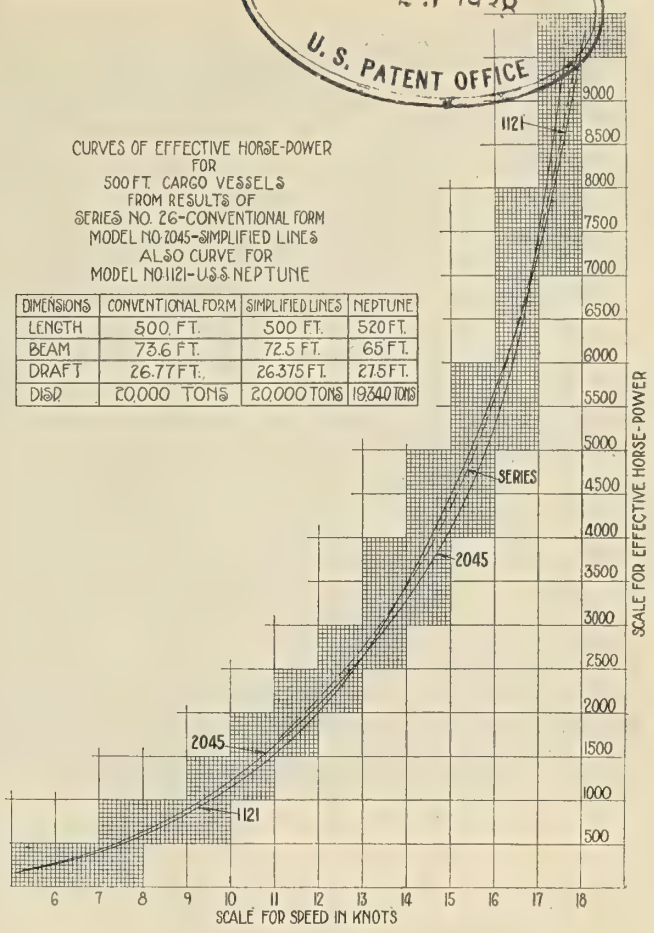

CURVES OF EFFECTIVE HORSE-POWER
FOR
500 FT. CARGO VESSELS
FROM RESULTS OF
SERIES NO. 26-CONVENTIONAL FORM
MODEL NO. 2045-SIMPLIFIED LINES
ALSO CURVE FOR
MODEL NO. 1121-U.S.S. NEPTUNE
DIMENSIONS | CONVENTIONAL FORM | SIMPLIFIED LINES | NEPTUNE
LENGTH | 500 FT. | 500 FT. | 520 FT.
BEAM | 73.6 FT. | 72.5 FT. | 65 FT.
DRAFT | 26.77 FT. | 26.375 FT. | 27.5 FT.
DISP. | 20,000 TONS | 20,000 TONS | 19,340 TONS
1121
SERIES
2045
2045
1121
SCALE FOR EFFECTIVE HORSE-POWER
SCALE FOR SPEED IN KNOTS

Fig. 6

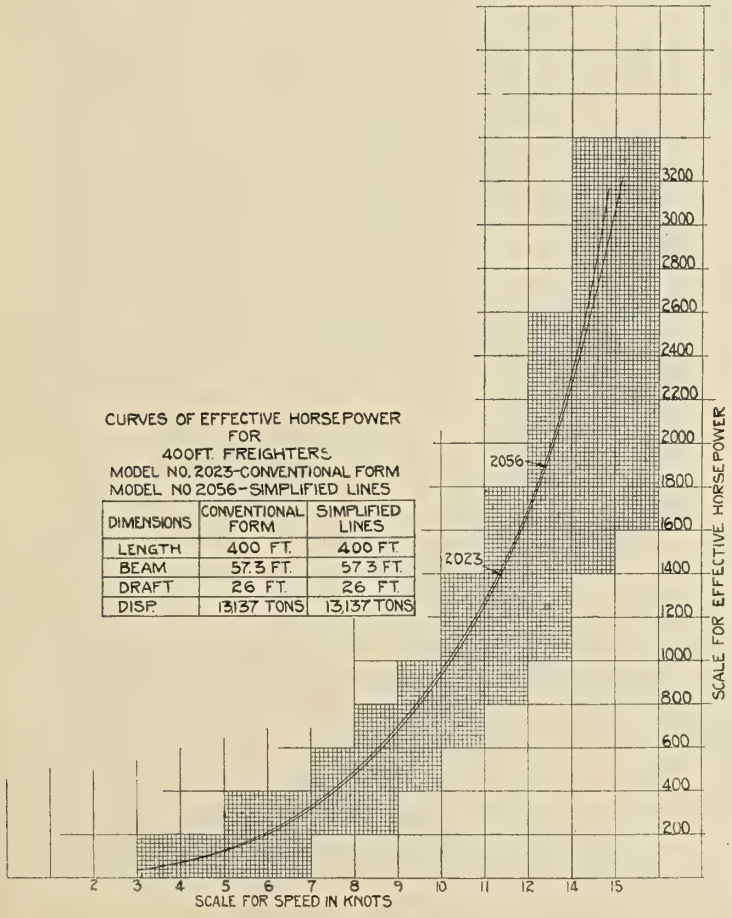

CURVES OF EFFECTIVE HORSEPOWER
FOR
400 FT. FREIGHTERS
MODEL NO. 2023-CONVENTIONAL FORM
MODEL NO. 2056-SIMPLIFIED LINES
DIMENSIONS | CONVENTIONAL FORM | SIMPLIFIED LINES
LENGTH | 400 FT. | 400 FT.
BEAM | 57.3 FT. | 57.3 FT.
DRAFT | 26 FT. | 26 FT.
DISP. | 13137 TONS | 13,137 TONS
2056
2023
SCALE FOR EFFECTIVE HORSEPOWER
SCALE FOR SPEED IN KNOTS

Fig. 5

single-screw type. At 10.5 knots it will be seen from the power curves, shown in Fig. 5, that the simplified form requires something less than 2 percent greater effective horsepower than for the conventional form. As Model 2,023 gave results which were considered to be good for this type of vessel, it follows that the simplified form, Model 2,056, would require appreciably less power than many cargo ships of conventional form in this general class now built and building.

In Fig. 3 are shown the lines of the United States collier *Neptune,* and of a 500-foot cargo vessel of simplified lines and somewhat greater displacement. The effective horsepower curves for these two models are given in Fig. 6. On this plate, also, is shown the estimated effective horsepower curve for a 500-foot ship of conventional form having the same displacement, 20,000 tons, and the same cylindrical or prismatic coefficient, .74. This latter curve is estimated from tests of one of a series of models of conventional form. The simplified form requires a little more power than the latter for speeds up to 13 knots. From that up to a speed of about 17 knots, the simplified form is the better, the advantage at a speed of 15 knots being in the neighborhood of 7 percent. On the same sheet it will be seen that the *Neptune,* which is of the conventional form, but 520 feet in length and of somewhat less displacement—that is, 19,340 tons—requires in general more power than the simplified lines.

The main dimensions of the models, or rather of the ships represented by them, are given in Table I.

In general, it appears to be safe to conclude that cargo vessels can be built of simplified lines which will give practically as good results from the resistance standpoint as those built from the present conventional lines. If propulsive efficiency is also taken into account, it is believed that the simplified form will have, at least in certain cases, advantages over the present type.

42138

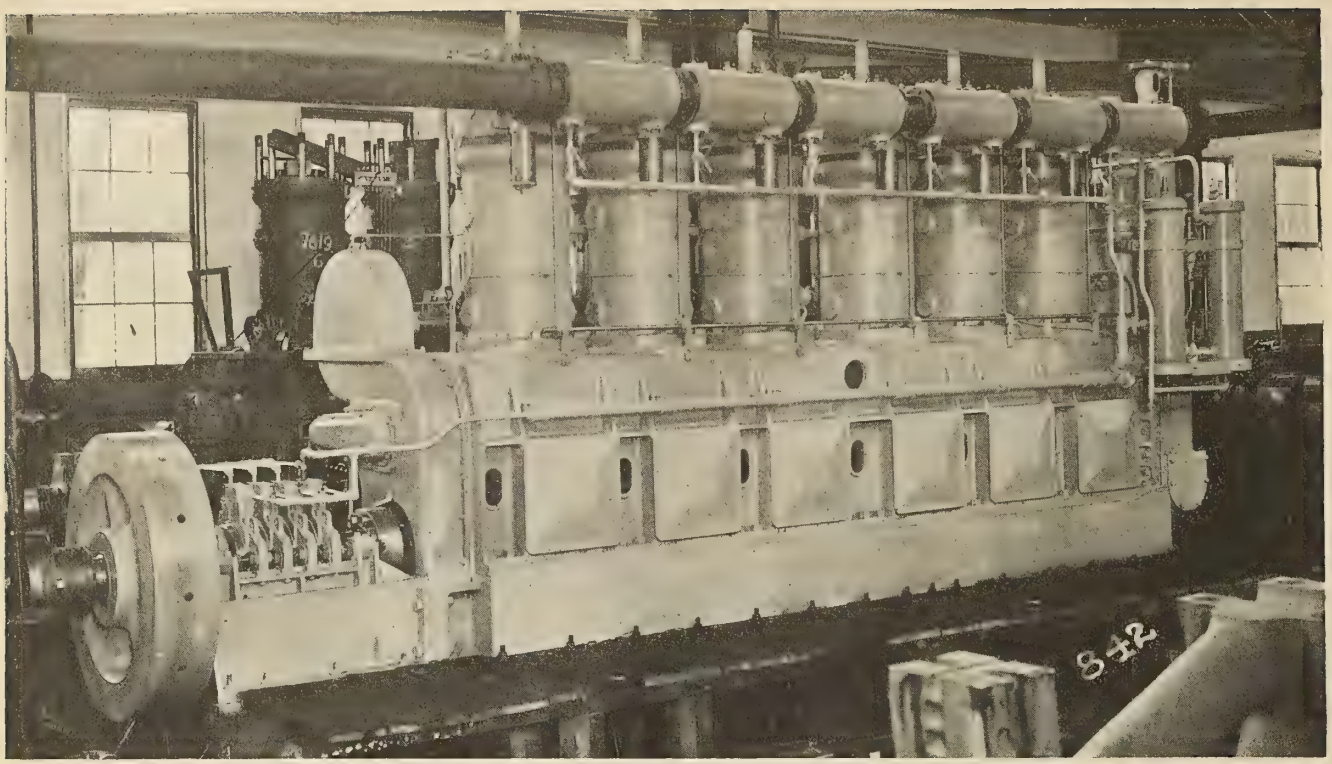


Fig. 1.—500-Horsepower Unit, McIntosh & Seymour Marine Diesel Engine

McIntosh & Seymour Marine Diesel Engines

Description of New, Heavy Duty, Four Cycle Type, Marine Diesel Engine Manufactured by McIntosh & Seymour Corporation, Auburn, N. Y.

THERE are now being shipped to the Pacific Coast a number of 500 horsepower heavy duty marine Diesel type oil engines, built by the McIntosh & Seymour Corporation, of Auburn, N. Y.

The engine has six cylinders and is of the four-cycle type, single acting and is directly reversible. The general arrangement of the engine is well shown in the various illustrations, and, as can be seen, the framing of these smaller sized units is of the box type, provision having been made for convenient access to all the working parts. The form of framing is such as to give the greatest stiffness with minimum weight, and reduces the size of the base, at the same time decreasing the weight of the engine.

Air Compressor

The air for atomizing the fuel for the working cylinders, also that required for maneuvering, is furnished by a three-stage compressor, located at the forward end of the engine and direct driven from the engine. In cases where the engines are used for twin screw vessels this compressor is of ample size to supply atomizing and maneuvering air for both engines in case of necessity. It is substantially built with intercoolers and aftercoolers arranged according to the most modern practice. The valves and cages are all accessible and removable as a unit, making their removal or renewal a simple operation.

Both the standard horseshoe marine thrust bearing and the "Kingsbury" thrust bearing are used by this corporation for their marine engines. The thrust bearing is carried in a substantial base, bolted securely and doweled to the engine base, and contains a large bearing located at its after end, making it possible to carry the flywheel overhung, as indicated in the illustrations. The main working cylinders are bolted to the top of the engine frame and are of a simple design provided with removable liners. The heads are separate from the cylinder, each containing an inlet exhaust, fuel and starting valve. The gear for operating these valves is clearly shown in the illustrations.

The cam shaft, as can readily be seen, is carried in a housing bolted to the engine framing, and driven by spur gears from the after end of the crank shaft. From the forward end of the cam shaft a fuel pump and speed limiting governor is driven.

Maneuvering Gear

The maneuvering gear, which can easily be understood from a careful study of the illustrations, is located at the forward end of the engine. The maneuvering, which is accomplished by simple operations, is all done in the proper sequence, due to the interlocking features of this device, thereby preventing the operator from damaging this equipment in any way due to the misunderstanding of its functions. The supply of fuel and the consequent control of the ship's speed is accomplished by one single lever.

There is arranged a control lever, within easy reach of the operator, which is devised to relieve the cylinders of any pressure, and when brought into operation automatically shuts off the atomizing air when these relief valves are open.

LUBRICATION

The lubrication for the working cylinders, piston pins and compressor is effected by the use of a Richardson Phenix force feed lubricator, driven by gears and suitably timed, so that the lubricating oil is delivered to the various parts during that portion of the cycle that is most beneficial. The oil from the crank pins, main bearings and other journals is supplied from a gravity system, through gang oilers conveniently located. As the engine is entirely enclosed, the base having a bottom cast in, the oil is all collected in the base, and is returned through a filter to the bearings by gravity. A small pump driven from the cam shaft is arranged for automatically handling this oil.

PREPARATION OF THE FUEL

The principal features of this engine are the thorough preparation of the fuel, which has proven to be very effective both on the marine and stationary engines built by the McIntosh & Seymour Corporation. The thorough cooling of the upper part of the liner and cylinder head is also a point not to be overlooked in the selection of an engine for continuous marine service. The cooling system on this engine is so arranged that salt water can be used for cooling purposes without coming in contact with steel studs or any parts liable to be affected by it. It has the same effective cooling, however, as on stationary engines and has the same even flow and proper circulation through the head.

In the shop tests of these engines, they are subjected to a continuous run, such as would be the equivalent of a normal ocean voyage, during which period numerous maneuvering trials are made. The average time consumed from the full speed ahead to full speed astern for fifty maneuvers is eight seconds. Very likely this time could be reduced, when the engine has become thoroughly limbered up and the operators are perfectly skilled in the handling of same. The fuel consumption is a trifle over .4 pound of fuel oil per brake horsepower hour, when operated at rated speed and rated load. It has been demonstrated that these engines are capable of a reduction in speed of 60 percent.

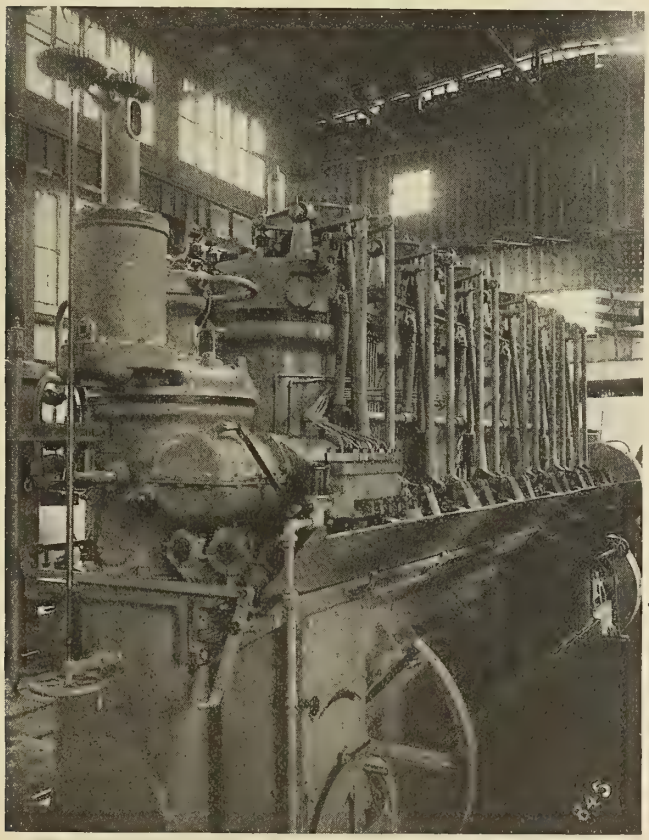


Fig. 2.—View Showing Valve Operating Gear and Air Compressor

The McIntosh & Seymour Corporation have been extremely liberal in the selection of all the accessories and equipment that they furnish with these engines, and one evidence of this fact is that the maneuvering tanks furnished with the engines, in which they carry 300 pounds, are of sufficient size to start these engines forty-four times, the minimum starting pressure being 80 pounds. The average reduction in pressure in this maneuvering tank, per start, is for each maneuver.

The standard sizes in which these engines are built by the McIntosh & Seymour Corporation are: 300 brake horsepower, 500 brake horsepower, 750 brake horsepower and 1,350 brake horsepower.

Progress in the Development of Freight Handling

NO other subject in connection with transportation is receiving more attention and expert investigation at the present time than the economical handling of package freight. The management of practically all of the leading railroads and steamship companies throughout the country have already delegated their most experienced engineers to the task of finding a solution of this problem.

It is interesting to note that while they are all working more or less independently, they are arriving at one common conclusion as to the fundamentals which will ultimately be the basis upon which the most economical method will be determined.

MOST ECONOMICAL METHOD

It is safe to state, and obviously so, that each loading and unloading of freight, while being conveyed on trucks from one point to another, promotes the tendency to increased cost per ton with the added factor of delay. It has been generally conceded by experts that the greatest economy can be obtained by keeping the freight on the same wheels or trucks until it reaches its ultimate destination—that is, from the point where the movement originates to the point where it is to be put in cars or storage.

While the same fundamentals apply in every case, there cannot be any fixed detailed arrangement that would suit all conditions. The details in each case involve the layout and spacing of tracks, arrangement and width of platforms, method of checking, weighing, etc., together with the selection of the mechanical equipment, which plays a most important part.

FUNDAMENTAL PRINCIPLES

In the larger terminals the traffic system involving the movement of trucks is also a very important consideration. There are a few principles, however, that apply in all cases and unless these fundamentals are fully recognized the desired economy need not be expected. As heretofore mentioned, the maximum economy can only be expected when moving freight from the starting point to its destination, by keeping it on its same set of wheels. This statement being accepted, the next consideration is the type of trucks or means for conveying from one point to another.

It has in the past been a common belief of many of

those actively engaged in or having supervision over the transfer of freight that the well-known two-wheel type of truck is the most practical for the purpose. As a result of more recent exhaustive investigations, it is now conceded that this type of truck must be discarded for general trucking before any appreciable reduction in cost is possible. We believe that this statement is now accepted by engineers studying this subject, as well as by those directly in charge of freight handling.

Four-Wheel Truck Displacing Two-Wheel Type

It is a fact that economy in this sense means increased tonnage per man, and four-wheel trucks are rapidly displacing those of the two-wheel type as a means of accomplishing this result. Many of the recognized types of such trucks are so constructed that one man can move 2,000 to 3,000 pounds, as against an average of 400 to 600 pounds on a truck of the two-wheel type.

The rolling surface of the platforms on which such trucks are to be used must necessarily be good, and this has a very important bearing on the movement of such trucks. This particular subject has never received the amount of attention it deserves, although one of our leading Eastern railroads recognizes its importance and is making a very careful investigation and study of the matter.

Most of the modern terminals, warehouses and transfer stations in our larger cities are of such size that trucking distance is also a very important consideration, and a further increase in the tonnage per man is possible by employing four-wheel trucks, using them as trailers and hauling them with storage battery tractors in trains of several trucks. By an ingenious arrangement the trucks are made to trail in the path of the tractor.

Investigation has also brought the fact to our attention that further efficiency may be obtained by using the trucks as distributing stations and storage bins, to be moved only when they have been loaded up to their maximum capacity.

Vertical Movement of Freight

So far consideration has been given only to the economical horizontal movement of freight. An additional problem is involved in the vertical movement of freight due to the rapidly growing necessity for the double deck or two-story pier or freight house. The advantages of this type of terminal are many and are very ably set forth in Mr. E. H. Lee's notes on L. C. L. freight houses as published in a bulletin of the American Railway Engineering Association, March, 1914. There are many cases where double decking of freight terminals is not a matter of choice, but becomes compulsory, due to local conditions and requirements.

Freight Kept Intact on Trucks

After a careful study of the requirements of the double deck terminal, one of the leading elevator manufacturers, in co-operation with railroad engineers, has developed two different types of apparatus to take care of this vertical movement. One of the prime requisites of apparatus of this character is to maintain to as great a degree as possible the economy thus far obtained by the use of four-wheel trucks and tractors when moving freight in the horizontal direction, and to carry out the original basic principle and accepted fact that the freight must not be reloaded, but kept intact on the same wheels or trucks until it reaches its destination. The apparatus must, in a sense, be "operatorless" to further reduce the expense of elevating the freight, and must also be of the highest grade to insure reliability of operation and low cost of maintenance.

Inclined Elevators

One type of apparatus is known as the inclined elevator and is designed to handle two-wheel trucks, also four-wheel trucks, either singly or in trains, and with or without tractors. This type of apparatus permits of the continuous movement of trucks from the starting point, along the horizontal, up the incline and along the horizontal at the other elevel to its final destination or unloading point, after which the empty truck is returned to the loading level by way of the nearest inclined elevator which is operating in the descending direction. As the inclined elevator is a continuous carrier, it has enormous carrying capacity.

Operatorless Vertical Elevator

The other type of apparatus is the electric elevator designed for vertical travel, and owing to the ingenious devices for starting and stopping the elevator and for the automatic opening and closing of gates or doors, it has been justly termed the "operatorless elevator." One of the important features of this elevator as developed for this class of service is the automatic leveling device which registers the platform accurately with the landing at all times under all conditions of loading. This is a requirement that is absolutely essential to the successful handling of trucks in their vertical travel, as the rolling of these loaded trucks on and off the elevator platform must be accomplished with the minimum amount of effort.

The type of inclined or vertical elevators that should be adopted is dependent entirely upon the special conditions involved in each individual case, and in some cases it may be advantageous to use both types. Both systems are now in use in some of our modern freight and steamship terminals, to the entire satisfaction of the companies using them.

With reference to the question of the capacity of these types of apparatus, it is the opinion of those who have made a careful study of the subject that it is not the capacity in tonnage they are capable of handling that is the dominating factor in determining the number of machines to be installed, but the judicious placing of these machines as a matter of convenience in handling and in reducing the horizontal trucking distance.

The economic pressure now forced upon our transportation systems by the increasing cost and scarcity of labor and the congestion at terminals makes it imperative that all operating heads shall through unity of effort and investigation soon determine the most suitable methods of mechanical freight handling. The decision of three of the most important systems, that the plan outlined is the most flexible and economical, may be an indication that this method will be adopted as a uniform practice.

Growth of the Shipping Board Emergency Fleet Corporation.—Within six months of its formation the United States Shipping Board Emergency Fleet Corporation has developed an organization of more than 1,000 employees, including a large force of technical experts, many of whom have left remunerative occupations to assist in the work. The corporation has sixteen offices in various parts of the country. It is supervising the construction of 1,118 vessels in 116 shipyards distributed throughout the United States. It is disbursing for the construction of these ships something within excess of a billion dollars a year. It is controlling substantially all the shipbuilding in the country other than all naval vessels, and its programme calls for the completion in 1918 of eight times the tonnage delivered in 1916.

Fig. 1.—Hunt Storage Battery Truck Towing an Empty Freight Car Along the Quay

Freight Handling at the Panama Canal

Old System Using Freight Cars and Hand Trucks Discarded —Problem Solved by Introduction of Storage Battery Trucks

THAT the United States Government did not await the pressure of war needs to develop a high grade of efficiency in some branches of its services is evident from what has been accomplished by Mr. C. H. Mann as receiving and forwarding agent for the Panama Railroad, a branch of the Panama Canal, to whom is assigned the duty of receiving and forwarding the several hundred thousand tons of cargo transshipped each month at the Port of Cristobal, Canal Zone. In keeping with the up-to-date quay construction at Cristobal, methods of cargo handling have been so improved that the old question of how to take care of "general cargo" is no longer a serious one for the stevedore. A ship discharging heavy machinery from one hatch, structural steel from another, while tons of small cases, barrels or bagged shipments came over the side from others, offered a problem in transportation that inventive genius failed to solve, until the storage battery truck gave the answer. And the receiving and forwarding agent at Cristobal has given a demonstration.

Old System of Freight Handling Inefficient and Costly

The old system made use of freight cars and hand trucks that carried the shipments arriving from European, Atlantic or West Coast ports to various points on the one and a quarter miles of docking space, thus making it available for reshipment on other bottoms to points of destination. The ancient hand trucking process was made unusually slow because of the very deliberate movement of columns of West Indian negro, Asiatic or native truckers, who moved just as fast as the slowest man in the parade and was subject to any delay this slow man could invent. The depressed railroad tracks in each of the piers could accommodate thirty freight cars, and the delays necessary to "spot" them for loading or unloading affected the entire force on either pier. And since it was not unusual to find more than three thousand men working as ships' gangs, distributed aboard the ship, trucking or loading cars, it is obvious that the work of a large number of laborers was affected or brought to a standstill by switching. Even if this shifting was delayed until idle periods, it was necessary to truck long distances to reach certain cars. The preparation of suitable runways required much labor. Also there were many instances of damage to cargo resulting in the repeated handling.

Another large expenditure of energy came from handling heavy cases. It was not unusual to find as many as forty crated automobiles, routed for various destinations, on the piers at one time. These had to be loaded on cars in some instances, in order to convey them to the vicinity of the berth of some ship that was to carry them forward. If often happened that cars loaded with heavy cases of this sort would have to be stored for weeks before they could be unloaded. The only alternative was to use a large number of laborers to haul them over dock floors on a dolly or similar truck.

In the summer of 1915 storage battery trucks were first introduced, and with their introduction a complete revolution of method of handling cargo began. Loaded slings were lowered from the ship to the platform of the truck and rapidly conveyed to some ship then loading, probably a half mile away, and lifted aboard in the sling that had lowered the cargo. Or if not for immediate shipment,

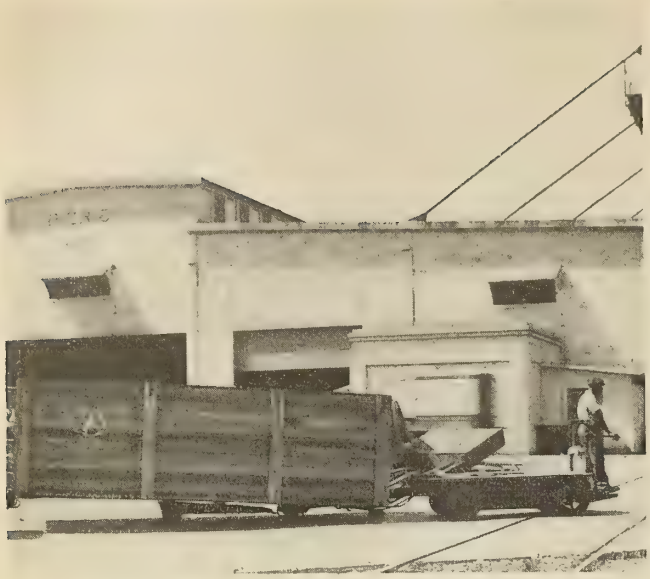


Fig. 2.—Hunt Truck Hauling Crated Automobile on Hand Truck

the bags or cases were stacked on the truck platform, thus permitting the heavier loads, and taken to the point that would be found convenient for future loading and there stacked. Even that part of the cargo that could be best handled aboard freight cars was much more rapidly transferred by running the trucks into cars. Hand trucking was dispensed with except for very short hauls, not only reducing labor costs immensely, but reducing the time of a ship in port to receive cargo to much less than that formerly found necessary.

Railway switching and the use of cars for storage have been so reduced that it is now a comparatively small item of cost and is no longer a source of delay in the work of ships' gangs. An estimate made by the receiving and forwarding agent was that the electric trucks have reduced the charge formerly made for crews and trains $1,700 (£350) a month.

One most important saving was in the handling of heavy cases. A crated automobile is now lowered over the ship's side and set on two hand trucks, one near the center and the other forward. One of the 2-ton Hunt trucks is attached to this by a short rope and is started with no one but the operator and one laborer to assist, and rapidly taken to its proper place for reloading at any point on the docks. Heavy cases of machinery, often approximating 6 to 12 tons, are handled in the same manner except that a special "dolly" is used instead of the hand truck, and a second or third electric truck is used, either in tandem or with one running in the reverse back of the case and pushing it.

Trucks Haul Railway Cars

There seems to be nothing that the trucks will not convey and do it rapidly and with the use of very little labor. It may be said in this connection that considerable shifting of railroad cars is effected in the same way. Two Hunt trucks will readily move a loaded freight car, gaining approximate speed in ten or fifteen seconds. One truck easily moves an empty car.

One use that has been made of the truck, but which is now tabooed, is in the shifting of barges. Sufficient tractive effort is available, but it is impossible to attain the truck's rated speed or control the barge so set in motion. This is mentioned only to show the sincerity of the stevedore's faith in the truck which efficient service has engendered in the minds of the men who use them. Tractive effort to them is simply "power to pull," so anything that needs to be pulled or pushed may properly claim the service of a truck.

Lifting heavy loads by block and tackle is a regular service. The hoisting of the heavy ore nets, which weigh about 1,000 pounds, to their storage platform or the place from which they are often suspended, is now a regular duty of the truck. In accomplishing this they have replaced no less than a half-dozen laborers and do more rapid work. When hoisted, the truck brake holds them until tied or landed on the platform. Properly geared, they will hoist anything within their capacity and they have often been used in lifting a load of more than a ton.

Truck operators on the Isthmus are nearly all West Indian negroes. A few are Chinese boys. All develop skill after a little experience that makes of them excellent operators. Of course, the personal element enters into it, developing some as careless, but the supply is abundant, so there is no difficulty in getting them. Harmful methods of handling trucks are more often due to improper demands by dock foremen, who have expected one truck to do the work of two or three. In spite of occasional mishaps, the service is excellent. As evidence, it may be truthfully said that the fifty-two Hunt trucks on the Isthmus, some of them now well along in their third year of a continuous, day and night service, are *all doing just as much work* as they did when they were new.

It may be well to explain that the Hunt trucks on the Cristobal piers are so operated that three-fourths of them are at work all of the time, both day and night. They come in in relays to have batteries charged, and by the aid of time gained during the idle dock periods between 5 A. M. and 7 A. M. and between 5 P. M. and 7 P. M.,

Fig. 3.—Hunt Truck Operating With Tackle Hoisting Freight to Second Floor of Terminal Shed

there is sufficient opportunity to keep the batteries in excellent condition.

Cost of Operation

The cost of operation is an easy calculation. Pay of operators plus the cost of charging, maintenance and minor repairs, amounts to about $2 (8/4) per day for each truck. But it must be borne in mind that a truck gives fifteen hours' actual service for that $2 (8/4) a day. At least 85 percent of this charge is for labor, while the actual cost of power or the current for recharging of batteries is not more than 8 percent or about 16 cents (0/8) per day. (Less than 1 cent (0/½) per kilowatt hour is the Isthmian rate.)

Probably water power alone can deliver equal energy at a like cost.

There is no attempt in this to estimate depreciation of equipment or include interest on investment. It may be said, however, that depreciation is less than is the rule for other types of commercial vehicle, and the electric vehicle of the industrial truck type seems almost indestructible. Witness the fact that those in Panama have made leaps off pier runways to concrete floors ten feet below, into railway track pits, even diving into the sea to a depth so great that it required the services of a diver to find it. They have collided with each other, with concrete walls and columns—have even been struck by a locomotive. Yet in no case have they been out of service long and all go about their work as if nothing had come into their lives but benevolent care.

Definite figures as to saving effected by the use of trucks in handling cargo on the Panama Canal piers are difficult to obtain and probably have never been clearly ascertained. But the general fact is known that the monthly cost of stevedoring has been reduced many thousands of dollars during the past two years. It has been unofficially stated that this has amounted to $30,000 (£6,150) a month, and such an amount does not seem improbable, for it would represent economics effected by the substitution of many efficient methods in the handling of ships' cargoes.

The largest single item of efficiency, however, would be found in the speed with which the work is done and labor cost curtailed in the service by the storage battery industrial truck.

Shipbuilding Department Formed in Bridgeport Trade School

The State Trade Education Shop of Bridgeport, Conn., which is conducted under the direction of the State Board of education and is in charge of James F. Johnson, director, has established a shipbuilding department which gives both day and evening courses in practical shipbuilding. This new department is co-operating almost entirely with the needs of the Lake Torpedo Boat Company in their problem of submarine construction. The teachers are men who have had practical experience at the trade and are able to give first-hand instruction in the details of the work.

The day work is confined entirely to the training of apprentices for the Lake Torpedo Boat Company. Young men enrolled in these classes work one week in the shipyard and the following week are under instruction at the trade school. They receive pay at the same rate while under instruction as while at work in the shops. The evening school instruction, for which over 160 men have enrolled, is for employees at present engaged in the various shipbuilding branches who wish to acquire further knowledge of the work.

The school has acquired 2,000 square feet of floor space in a new office building, which is used as a mold loft in which the actual work is laid down. Thorough study is given to the branches relating to ship fitting.

S. S. Fairmont

THE S. S. *Fairmont,* the first of a contract for five sister ships, placed with the New York Shipbuilding Corporation, Camden, N. J., by the Coastwise Transportation Company, Boston, Mass., about a year ago, was launched on December 8, about 90 percent complete. Although built to the order of the Coastwise Transportation Company, the vessel has now been taken over by the United States Shipping Board Emergency Fleet Corporation.

The vessel is a steel single screw collier of the single deck type with poop, bridge and forecastle with machinery amidships designed for coastwise and overseas trade. She is 395 feet 4 inches long overall, 377 feet 4 inches long between perpendiculars, 55 feet beam molded and 24 feet 5 inches depth molded. There is a double bottom all fore-and-aft, divided into seven compartments for water ballast or fuel oil, the forward and after peaks being for ballast. The total capacity for water ballast in the double bottom and peak tanks is about 1,900 tons.

The capacity of the cargo holds, including the trunks, measured to the top of the tank, is 337,500 cubic feet. The coal bunkers have a capacity of 1,350 tons at 43 cubic feet. The vessel is to carry 8,600 tons total deadweight on the British Board of Trade freeboard, summer draft, and in this trim will make 10½ knots sea speed under ordinary conditions.

Eight cargo hatch openings, each 15 feet 9 inches by 28 feet, are provided to facilitate the rapid handling of a cargo of coal. The hatch coamings are strongly built, forming a solid girder along each side, being suitably braced and secured to the deck so as to carry the deck between the webs and enable pillars to be dispensed with in the main holds. Each hatch has a single cover made of steel plate.

The vessel is schooner rigged with two steel cargo masts fitted with tubular steel booms, each capable of handling a 5-ton working load except one boom on the foremast, which is designed for a 12-ton working load. Instead of stepping the masts on the tank deck, they are heeled on a strongly built platform on the bulkhead 5 feet below the deck. King posts are fitted for handling the hatch covers, one pair for two hatches.

Propulsion is by a triple expansion surface condensing reciprocating engine with cylinders 25, 41½ and 70 inches diameter with a common stroke of 46 inches supplied with steam at 195 pounds working pressure by three single-ended Scotch boilers, 13 feet 10 inches mean diameter and 10 feet 6 inches long between heads arranged for either coal or fuel oil burning. The main condenser is independent of the engine and contains about 3,300 square feet of tube cooling surface. An auxiliary condenser of 800 square feet tube cooling surface is also installed to take care of all auxiliary machinery. The vessel has a complete equipment of fire, bilge and sanitary pumps, ice machine and electric light plant.

The United States Shipping Board has allotted $3,500,000 for building twenty-four barges and four towboats to be utilized in river traffic between St. Louis and St. Paul.

Development of Machinery in the United States Navy During the Past Ten Years*

Magazine Refrigeration—Cruising Economy of Destroyers—Performance of Reciprocating Engines—Mechanical Reduction Gears—Electrical Propulsion

BY REAR-ADMIRAL C. W. DYSON, U. S. NAVY

The dreadnaughts up to this time authorized or building were of the five-turret type with the magazines for one turret located between the engine and firerooms. In order to reduce the naturally high temperature of this magazine some system of artificial cooling was necessary.

Two systems have been tried out, one with closed air circulation and the other with the cooling medium circulating through pipe coils in the magazines.

Magazine Refrigeration

Difficulty was experienced with the first system when first applied, due to the moisture in the air frosting up the air coolers through which the refrigerated air from the machines circulated. These cooler pipes would become heavily coated with frost, which is a most excellent nonconductor, and when so coated no further degree of cooling of the magazine air was possible. The persons operating the machines did not appreciate this fact, so, as the frost gathered, the machines were driven harder and harder until something would break.

Reports were immediately made laying all the troubles to "defects in design," when really the trouble was due entirely to operation. This criticism of "defects in design" is met with constantly whenever any troubles are experienced. The personnel are always held blameless, and quite naturally, as those operating the machinery are doing so to the best of their ability and are loath to admit that the fault might possibly rest with them.

Following these ships, appropriation was made for the *Arkansas* and *Wyoming* and for eight destroyers. The plans prepared for the two battleships were practically duplications of those for the two preceding vessels.

Proposed Combination Machinery

The Department did, however, invite bids on a layout of combination machinery developed by it. This differed from the ordinary type of combination machinery that had been used in the merchant marine. In this latter machinery the reciprocating engines and the turbine combined with them each developed about the same power, the steam pressure at the turbine inlet being that which is usually met with at the exhaust of a triple expansion engine, about 12 pounds absolute. With the ordinary merchant vessel the ranges of speed and power used in actual service are very limited, and the machinery can be designed for maximum efficiency within these ranges. With vessels of war of high or moderately high speeds the range between ordinary cruising speed and power and full speed and power is extensive, and the combination machinery must be so designed that the turbine will deliver power down to and, if possible, slightly below the cruising speed in order that it may not cause a drag and an absolute loss in efficiency. To accomplish this it is necessary to design the reciprocating engines as compounds, but having the same ratio between the high and low pressure cylinders as exists in the ordinary triple expansion engine. The function of the low pressure cylinder is then performed by the highly efficient low pressure turbine. The initial pressure at the turbine at full power in such a case should be about 30 pounds absolute. The whole scheme really can be considered as one in which the comparatively inefficient H.P. turbine and L.P. cylinder are replaced by the much more efficient H.P. and I.P. cylinders and L.P. turbine.

Bids were received for such an installation, but it was decided not to go into the experiment at that time. About two or three years later, the French Government did install a similar arrangement in several new battleships. With this same year, 1909, the subject of electric propulsion first made its appearance on the naval stage. Mr. W. L. R. Emmet approached the Navy Department with proposals to fit electric propelling machinery on one of the new vessels, but the Bureau of Steam Engineering advised against it, considering that the new problem should be at least partially solved by installing and trying out an installation on a less important vessel before committing itself to its installation on a capital ship. The opportunity to do this did not offer until two years later.

The destroyers of this program were all of the two-shaft design, four of them having improved Zoelly turbines, two Curtis turbines and two Parsons turbines, the latter having a H.P. turbine on one shaft, a low pressure on the other, and having only a single condenser, which constitutes a very weak point in these vessels.

Destroyers

These destroyers are the starting point for high cruising economy in destroyers, the General Board of the Navy having required that they should have a certain specified cruising radius at 15 knots speed.

This requirement necessitated other than ordinary cruising turbines to realize the necessary economy, and therefore, as the speed of rotation at 15 knots was comparatively low, small compound reciprocating engines working in combination with the turbines were fitted, connected to the main shafting by disconnecting couplings. These engines were disconnected for speeds above 16 knots. The combination was an unqualified success so far as the resultant economy was concerned, a reduction in fuel of from 25 to 50 percent below that required for the main turbines only was realized, 49 percent at 10 knots, 37 percent at 13 knots and 25 percent at 16 knots, results well worth the expense and slight complication involved.

Some of these engines were made reversing, but the majority were made non-reversing, which was the form preferred by the Department. Barring some slight troubles, everything worked well with the exception of a form of friction clutch which had been fitted on four of the vessels.

The history of this clutch is a very good example of the difficulties the inventor encounters in the development of a new idea before success is finally realized, and, being such, I will detail this history to you.

* Reprint from the Journal of the Society of Naval Engineers, continued from December, 1917, issue.

The clutch was oil-controlled of the single friction-disk type, and was designed by Mr. John F. Metten, Chief Engineer of the Cramps' Shipbuilding Company, in an honest and finally successful endeavor to meet the Department's specifications. These called for the small cruising engines to be coupled to the main shafts by couplings which could be connected and disconnected with the machinery in motion.

Metten Friction Clutch

The clutch, as already stated, was of the friction type. The single friction disk of plate steel was thickened into a boss at the center and bolts passed through this boss and a boss in the end of a short length of intermediate shafting fitted between the after end of the engine shaft and the forward end of the main shaft. The after end of this intermediate shaft was forged out into a Tee end, which was held up to and worked in a slot across the end of a disk on the main shaft, thus providing a flexible coupling to care for changes in alinement.

When the couplings were put into service the first troubles were experienced with the coupling disk, which would heat up under load and warp. To obviate this trouble the edge of the disk was divided into segments by slitting it, the slits cutting in radially for about four inches. The remedy was effective.

The next weak point to develop was the bolting of the disk to the shaft. These bolts were then made much heavier. The shafts then began to break at the point where the form changed from cylindrical to the Tee. This form of flexible coupling was then abandoned and a flexible coupling with entire circumferential engagement was fitted. Everything but the cylindrical portion of the shaft having had its inning and been corrected, the body of the shaft began breaking up badly and some of the shafts broke. The trouble was analyzed as due to torsional vibration and the shafts were at once discarded and replaced with new ones of heavier weight and larger diameter. Since all of these changes were made the clutches in all their parts have been satisfactory.

This year's appropriation also called for one collier. This vessel, the *Cyclops,* was fitted with reciprocating engines of the straight-port type, and, when finished and tried out, gave a very creditable performance. She is mentioned here because a sister ship was laid down the next year fitted with mechanical reduction gear, and the year following a similar vessel fitted with electric propulsion. These new forms will now be taken up.

Mechanical Reduction Gear

For several years anterior to the date of which I am speaking, Sir Charles Parsons, in England, and Rear Admiral George W. Melville, coöperating with Mr. John H. MacAlpine, under the patronage of Mr. George Westinghouse, had been investigating the possibilities of mechanical gearing for interposition between turbines and propeller shafting in order to combine the high efficiency of the steam turbine with the high efficiency of slow-turning propellers. This was not the first appearance of such gearing, however, as it had been used in a few instances years before, but for a quite different purpose. The earlier reciprocating engines were very heavy, of long stroke, and very slow moving, and the gearing in these cases was interposed to bring the revolutions of the propellers up.

Sir Charles Parsons already had an installation in successful operation on the merchant ship *Vespasian.* Mr. Westinghouse had built a unit and had carried out a very successful shop test, but as yet had made no marine installation. The Maryland Steel Company, which received the contract for the *Neptune,* the sister ship of the *Cyclops,* proposed to the Navy Department that the main propelling machinery be changed to turbines and reduction gear and the Bureau of Steam Engineering recommended approval of the proposition.

As the installation was experimental, the contract was so drawn that in case of failure the turbines and reduction gear would be replaced by reciprocating engines similar to those of the *Cyclops,* and in order to allow of this the shaft lines and dimensions were so fixed as to allow the one type of machinery to be removed and the other installed without change of line shafting.

The Westinghouse gear as originally designed had the pinion bearings carried on an I-beam, which provided a certain amount of flexibility for the pinion shaft and was supposed to take care of any small disalinement which might occur between pinion and gear wheel. Before the gears were built, however, this I-beam was replaced by two hydraulic cylinders to which the oil was pumped by the bearings and which by the oil pressure shown gave an accurate gage of the power being exerted.

Westinghouse Gear

Mr. Westinghouse, being before everything else an inventor, saw here his opportunity and allowed his inventive genius to run riot. He designed a new type of marine turbine, the first stage being an impulse one, the remainder being of the reaction type. The big difference between this turbine and the ordinary Parsons turbine was in the location of the backing turbine. This was in the same casing with the ahead turbine, but was directly forward of the H.P. end of that turbine, being steam-sealed from it by a dummy fitted with labyrinth packing. The backing turbine exhausted through the rotor drums to the regular exhaust outlet. This turbine was a failure from the beginning, as there was continual loss due to steam leakage from the ahead to the backing side, causing both loss in steam and in power. He designed a bridge control on the air brake principle by which the main engines could be operated from the ship's bridge. This never won favor, and but recently a request has been received from the vessel to remove it. He installed Westinghouse-LeBlanc water-sealed rotary air pumps. These used salt water as the sealing medium and discharged it overboard. The loss of fresh water due to the vapor which became entrained with this salt water and was then discharged overboard was enormous. Everything about the installation which had been installed by the Westinghouse Company was a failure with the exception of the reduction gears, which were unqualifiably successful.

Later the turbines were removed and replaced with others of the same type but greatly improved design; the air pumps were replaced with others using fresh water on a closed circuit as a sealing medium; and in order to improve the efficiency of propulsion, the gears were changed in order to reduce the propeller revolutions from 132 to 110 at full power. The new installation is now on the vessel, and, after passing through a few vicissitudes, is operating satisfactorily.

Electric Propelling Machinery

Let us now turn to a more pleasing picture. I refer to the installation of electric propelling machinery on the collier *Jupiter.* This installation was undertaken by the General Electric Company the year following the beginning of work on the *Neptune.*

This being also an experimental installation, the Navy Department guarded itself from loss exactly in the same

manner as had been done on the *Neptune*. This necessitated the installation of only one main turbine and generator in order that the shaft lines might not be disturbed.

The generator turbine was of the G. E. Curtis type. The generator is totally enclosed and the rotor has fans on each end which take air in at the bottom of the casing and blow it out through the windings, passing thence through a discharge duct on top of the generator casing. The exciting current for the revolving field is supplied to slip rings on the generator shaft by one of the ship's lighting sets.

The motors, one on each shaft, are of the induction type, with a stator 120 inches in diameter and a rotor 110 inches. They are located in watertight pits which cannot be filled by water from below. Being situated directly under the engine-room hatches, they are liable to be deluged with water from above, and the insulation of the windings is therefore made waterproof and are intended to give safe running when partially submerged.

The first turbine constructed for this job was not entirely satisfactory to the General Electric Company and they voluntarily scrapped it and constructed a new turbine having very greatly improved blading. The results obtained with the new turbine showed much improvement and the completed units were installed. Barring the coming adrift of an internal turbine bolt, the installation has been perfectly satisfactory since first tried out. It has been subjected to water, insulation has been injured so that a spark jumped from one end of the armature to the other, the ship has gone through exceptionally heavy weather, and the installation is as satisfactory to-day as when first installed.

Reciprocating Engines for the Texas and New York

The next vessels to be contracted for—that is, battleships—were the *Texas* and *New York*, and the Navy Department was accused of having taken a step backward when it was decided to put reciprocating engines in these vessels. The reasons for this step will now be given. A careful study of the performance of the *North Dakota* and a better understanding of the factors governing propeller performance had assured the Bureau that no great economy of propulsion could be expected so long as the turbine builders adhered to what was at that time current turbine practice. That is, as pointed out before, they were sacrificing propeller efficiency deliberately in order to obtain a high turbine efficiency and so be able to hold down weight and space to the lowest possible limit. The Bureau, by its action, was attempting to force them into a change by which the greatest combined efficiency of turbine and propeller could be obtained, and, as later developments indicated, these efforts finally met with success.

In furtherance of this idea, while the plans as prepared showed an installation of Parsons turbines, the Bureau unofficially informed some of the prospective bidders that a proposal to fit reciprocating engines would be given serious consideration.

When the bids were opened the Newport News Company was found to have submitted such a proposal and the Bureau of Steam Engineering promptly recommended acceptance. This action of the Bureau had not yet become public when parties interested in the Curtis turbine invaded Washington and began a vigorous campaign for that turbine, at first urging the installation of turbines similar to those they were then installing on the Argentine battleships *Rivadavia* and *Moreno*, turbines which had to be nearly completely rebladed with a heavier type of blade than originally installed before they could even get through their preliminary acceptance trials. When they did finally pass these trials the water consumption trials at all speeds were far in excess of the guarantees. Later in the campaign the advocates of the Curtis turbine proposed the installation of compounded turbines—that is, a high and a low pressure turbine on each shaft, the installation to be a two-shaft one. The fight was taken up by the Bureau and was carried to the General Board, which was made the judge in the case by the Navy Department. No guarantees were too severe for the turbine people to meet, on paper, so long as they could equalize the estimated performance of the reciprocating engines. Fortunately, the Bureau was the victor, and reciprocating engines were installed in the two vessels now known as the *Texas* and *New York*, and the Navy Department has never had occasion to regret this action. It is pertinent here to call attention to the fact that some of the parties engaged in this controversy on the turbine side are now even more actively engaged in a newspaper campaign to force turbine-driven reduction gear into the battle cruisers which we are just starting to build, and in this case every bit of evidence they have to support their contentions as to the superiority of the installation they are advocating over that of the electric drive is hearsay of the most meager description.

As stated before, the Department has never had occasion to regret its decision in regard to the type of machinery installation for the *Texas* and *New York*, for from the coal consumption reports received from the fleet, it costs no more to drive the *New York* at 12 knots than it does to drive the *Delaware*, and 17 percent less than the *Florida* and *Utah*, and 27 percent less than the *Arkansas* and *Wyoming*, even with the much heavier displacement of the *New York* than that of the three vessels first named and the slightly less displacement of the *Arkansas* and *Wyoming*.

Turning again to the destroyers, the next step forward in the design of their machinery consisted in the adoption of turbines and reduction gear for cruising units, these replacing the small reciprocating engines which had been fitted in the preceding classes. This change was brought about by the General Board, which raised the speed for the guaranteed cruising radius from 15 up to 20 knots. As this latter speed required too high revolutions for a reliable reciprocating engine, it became necessary to look for something that was reliable to replace it. Turbines with reduction gears was the answer.

To carry the destroyers up to date and clear them off the board, I will carry them through their remaining history at once. The next and only change which has occurred with their machinery since the adoption of reduction gear for cruising has been to pass from the direct-connected turbine main drive and adopt turbines and reduction gear for this purpose. This action led to the abandonment of special cruising elements for destroyers, as quite a good (and nearly as good as with the cruising elements) economy at cruising speeds could be obtained with the main turbines, while the economy at high speeds was enormously increased. The weights of the six types of destroyer machinery, based on designed power, are as follows:

	Main Propelling	Cruising Element	Total Weight, Pounds Per Designed S.H.P.
(1)	Parsons turbines	Cruising turbines	51
(2)	Curtis turbines	Cruising nozzles	56
(3)	Parsons turbines	Cruising engines	47.5
(5)	Curtis turbines	Cruising engines	48
(6)	Parsons turbines	Reduction engines	46
(7)	Curtis turbines	Reduction engines	46.5
(9)	Geared turbines		42

(To be continued.)

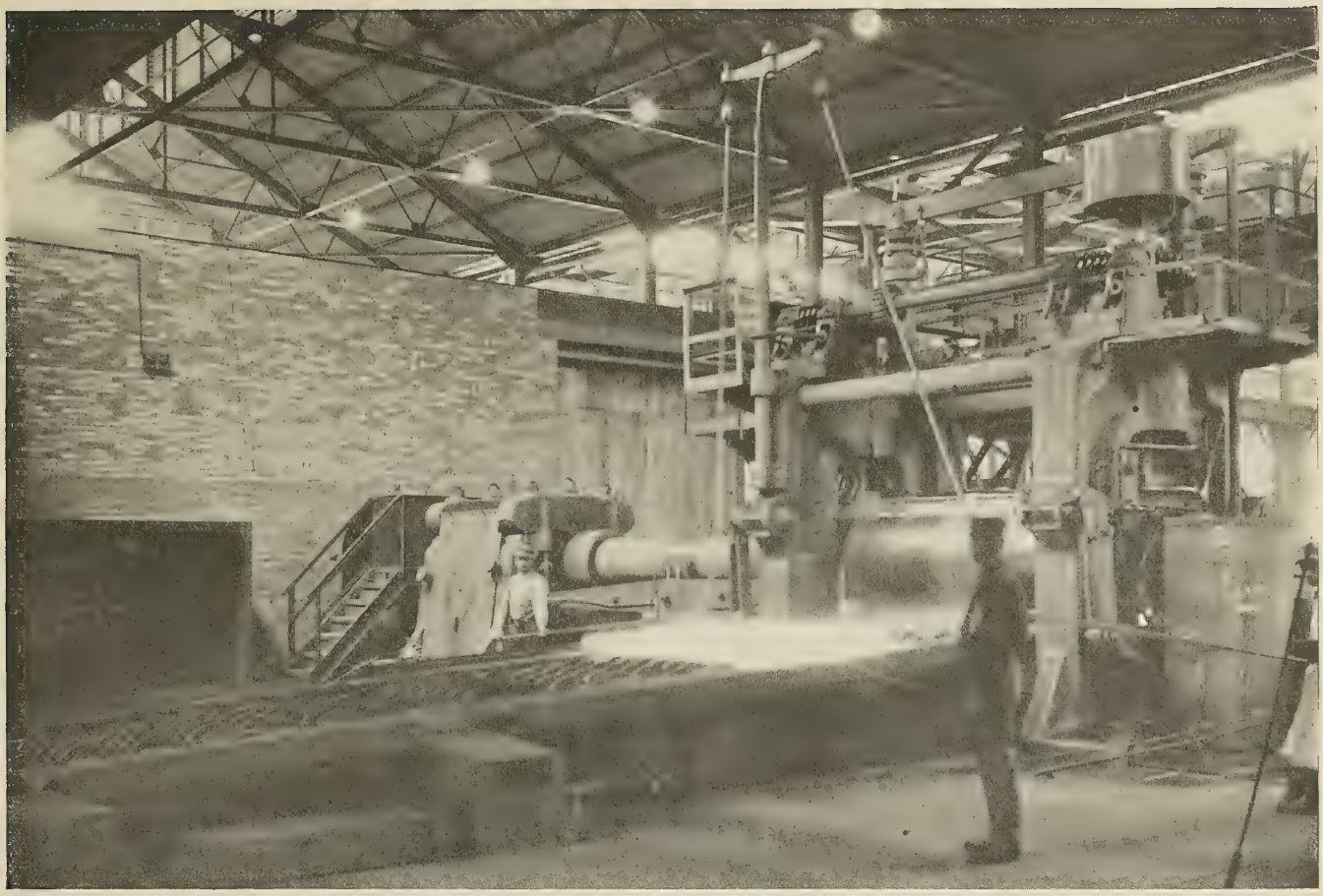


Fig. 1.—Front View of 110-Inch Liberty Plate Mill Rolling Ship Plates, October, 1917

The Liberty Mill

110-Inch Plate Mill Built in Record Time by Carnegie Steel Company for Rolling Ship Plates for Emergency Fleet

THE construction of the 110-inch Liberty Plate Mill by the Homestead Steel Works of the Carnegie Steel Company in six months is an engineering achievement which justly deserves mention, even at this present time of rapid construction of buildings for emergency uses.

The Liberty Mill is an emergency mill built in the first instance to roll ship plates for vessels under construction for the Emergency Fleet Corporation, but it has been built in the most substantial way to serve the nation when the war is done. A mill of this size had not been under consideration at Homestead Steel Works when the order to build the mill was received. There were no spare parts which could be taken from other mills, no engines, no machinery available. No pencil had ever been put to paper in the way of preliminary estimates or designs.

Work Involved

The construction of the mill required the removal of 70,000 tons of scrap and miscellaneous material on the site (2,400 carloads); 71,950 cubic yards of excavation; 50,120 cubic yards of back fill; 17,147 cubic yards of concrete; the laying, changing and removal of 40 miles of temporary track; the construction of a 5-foot sewer 1,000 feet long; it required the construction of an addition to the Carrie Furnaces power house with a new 46-inch by 66-inch Snow twin tandem gas engine direct connected to a new General Electric Company 3,750 KVA generator; the building of a transmission line two miles long across the Monongahela River on two towers 115 feet high and 1,007-foot span; the building of seven mill buildings with a total area of 215,000 square feet; the manufacture, fabrication and erection of 3,390 tons of structural steel; together with the heating furnaces, rolling mill, 4,000 horsepower main motor, subsidiary motors, straightening rolls, shears, cranes, etc., necessary for the operation of the mill itself.

Labor

The mill was built by men whose hands were already full; men whose works were operated to capacity with unusual difficulties at an unprecedented time; men whose minds were occupied with the problems of insufficient coal supply, scarce and inefficient labor and transportation difficulties. Ordinary labor was practically unobtainable; in consequence steam shovels and machine tool methods were in use. Orders were received to build the mill on April 17, 1917, but it was six weeks after that date before it was possible to secure laborers.

Volunteer labor saved the day. Officials and clerks from various Homestead Steel Works offices, both general and departmental, officials and clerks from the general offices, Pittsburgh, Homestead Steel Works department heads, mechanics of all trades, skilled and semi-skilled mill workmen were represented in the forces which on Saturday afternoon, Saturday night and Sunday cleared up the stagnation which had accumulated during

the week on account of the shortage of regular laborers. At one time as many as 450 volunteer workmen were on the job.

ORGANIZATION

The work was carried forward under the supervision of A. A. Corey, Jr., general superintendent, Homestead Steel Works; R. H. Watson, assistant general superintendent, and J. W. Grady, manager producing departments. Daily conferences were held at the site at 7.30 A. M., and each division of the organization had the direct oversight of that portion of the new plant which it was finally to operate, including design of machinery, its purchase, etc. F. B. Schaeffer, chief civil engineer, was responsible for the grading of the site, laying of foundations, sewers, underground work, equipment, back fill, railway tracks, etc. The design of the mill buildings and the general mechanical engineering work was in the hands of A. W. Soderberg, chief mechanical engineer. Cranes, motors and all electrical equipment came under C. A. Menk, chief electrician. Richard Moon, master mechanic, had the oversight of the mill machinery, pumps, etc. Charles S. Frye was superintendent of construction, and Kenneth Lean superintendent of transportation and labor. James Horton, efficiency engineer, acted as special ambassador to the various contracting firms building mill equipment. Each department worked out its own problems.

SITE AND FOUNDATIONS

The 110-inch plate mill and its tracks cover an area of nine acres on the Monongahela River, west of the Howard Axle Works in West Homestead. On this site on April 17, 1917, were 70,000 tons of scrap and miscellaneous material, or 2,400 carloads. Thirty thousand tons of scrap, 2,000 tons of loam, 700 tons of black clay and odd lots of sand, gravel, chrome ore, etc., had to be moved before the first pick could be sunk, and the first pick was a 73-ton, 2½ cubic yard Marion steam shovel borrowed from the Union Railroad.

The foundations are all concrete, continuous for the brick buildings and of the single pier type for the main mill building columns. The concrete was mixed in eight Smith & Co. concrete mixers, four of them of ⅓ cubic yard capacity and the other four the small mixerette, 5 cubic-foot size.

MILL BUILDINGS

The group of buildings comprise seven distinct units at West Homestead in addition to the power house extension at Carrie Furnaces. The slab yard building is 70 by 293 feet; the heating furnaces building, 106 by 293; the mill building, 70 by 293; the shipping building, 80 by 864; the shear building, 80 by 764. The mill superintendent's office, 46 by 64 feet, is of semi-fireproof construction and contains offices, vault, toilet and rest room.

It is customary in rolling mills to have the mill building itself contain equipment in the way of pumps, motors, accumulators, etc. In this installation all of the subsidiary machinery has been removed from the main mill building and segregated in a special mill office, comfort and power building 242 feet long by 40 feet wide, built of brick and covered with Barrett specification roofing. This building contains three 500 kilowatt transformers built by the Pittsburgh Transformer Company, two 1,500 cubic foot Bury air compressors, two 5⅝- by 12-inch Epping-Carpenter duplex pressure pumps, two water filters, return water tank, 24-inch accumulator, and in addition the physical testing laboratory, physical test bending room, physical testing machine shop, locker and wash room with 288 steel lockers, inspector's offices, janitor's room, oil room, toilet room, rest room, vault, etc., and has its own heating plant in the basement.

The separation of machinery from the mill proper has been carried a step farther so as to make the installation clean, clear and safe. The 4,000 horsepower motor which drives the mill is housed in its own separate brick building built under the main mill roof and containing in a separate room the switches, resistance coils and other accessory electrical equipment.

The steel work for the mill buildings was designed by the American Bridge Company. It was fabricated in part by the Ambridge plant of that company and in part by the Upper Union Mills Fitting Shop of the Carnegie Steel Company. The steel work for the Carrie Furnaces power house extension was detailed at Homestead Steel Works and fabricated in its own shop. The ability of the works to manufacture and fabricate its own steel and to do machine shop work was quite a factor in the rapid construction of the buildings.

Buildings and machinery were designed and ordered without any rechecking. Drawings came out of the drafting room daily, and the most remarkable feature of the engineering work was that there were absolutely no mistakes. Not one piece went out of the shops that had to come back.

The mill buildings were erected by the American Bridge Company with its own force. Work was begun on Thursday, August 2, and finished on September 22 in the record time of forty-nine days.

POWER

This mill is the first electrically driven plate mill to be operated by the Carnegie Steel Company. It is entirely electrically driven from start to finish. The main motor is a 4,000 horsepower General Electric motor. The crane motors, table motors, shear motors, motors for driving pumps, etc., were built by the Westinghouse Electric & Manufacturing Company.

The power furnished is alternating current, 3-phase, 25-cycle, 6,600-volt, developed at a central power station at Carrie Furnaces by a 46-inch bore by 66-inch stroke Snow twin tandem gas engine directly connected to a General Electric 3,750 KVA generator. Power is transmitted to the mill on overhead lines carried on poles. This line spans the Monongahela River on two towers 115 feet high having 30-foot bases. The main mill motor takes current at the original voltage. At the subsidiary motors the voltage is reduced to 220.

ROLLING MILL MACHINERY

The mill itself is a three-high plate mill with 110-inch length of roll body. Top and bottom rolls are 36 inches in diameter, middle roll 21 inches. The rolls are chilled iron and were made by the United Engineering & Foundry Company, of Pittsburgh.

The mill was designed by Homestead Steel Works and built jointly by Mackintosh, Hemphill & Co. and the Mesta Machine Company, Pittsburgh. Mackintosh-Hemphill made the mill, large castings for charging machines and cranes, including mill housing. Machining was done by Homestead Steel Works. Mesta Machine Company made the pinions, the pinion housing, the pinion shoes and the mill shoes. The practice on motor-driven mills has been to use machine-cut pinions. It was impracticable to have these cut and so they were made machine molded and operate as noiselessly as any cut gears.

The mill is served by seven cranes and two overhead traveling charging machines, namely:

One 15-ton crane in slab yard.

One 50-ton crane in mill building.

Fig. 2.—Straightening Rolls and Cooling Tables

Three 10-ton double trolley cranes in shipping building.

Two 10-ton single trolley cranes in shear building.

Two 10-ton overhead traveling charging machines in heating furnaces building.

All these cranes and their equipment were made by Homestead Steel Works itself. There are three main shears, two side shears with 144-inch knife, and an end shear with 110-inch blade, all made by the Morgan Engineering Company, Alliance, Ohio. The two scrap shears were made by the Cleveland Punch & Shear Works. The straightening rolls were made by R. S. Newbold & Son Company, Norristown, Pa., and consist of a machine with nine rolls 14 inches in diameter and 116 inches long. The roll tables were made by Homestead Steel Works in their own shops.

The heating furnaces building houses eight regenerative heating furnaces. At present furnaces are heated with natural gas. They may be heated with either natural gas, oil or tar. Ultimately, when the full schedule of improve-

(*Concluded on page 42.*)

Fig. 3.—Charging Machines and Reheating Furnaces

Duties of Newly Trained Marine Engineers on Merchant Vessels—III

Notes on Feed Water—Testing Water for Corrosiveness—Construction and Operation of Evaporators—Principal Systems of Forced Draft

BY C. H. WILLEY

BOILER feed water should be as free from impurities as possible. Some of the most serious met with are oil, grease, air and salts of sea water. To prevent these from entering into the boiler will require considerable effort and attention of the engineer. On board ship the sea water is evaporated and distilled to obtain that needed for make-up feed when the feed tank capacity is used up. The distilled water is apt to be corrosive, so it will be seen that it is important that the amount of make-up feed should be kept to a minimum.

Scrap iron is sometimes suspended in the hot well or feed tanks to absorb the oxygen. If a feed heater is used, there is generally fitted a ½-inch pipe leading from

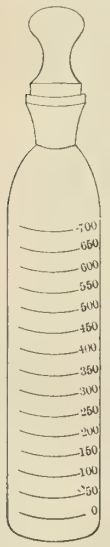


Fig. 1

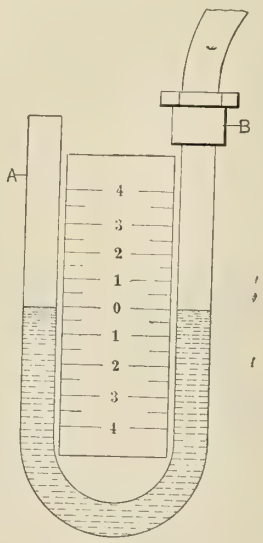


Fig. 2

the hottest part of the water space to the hot well or feed tanks. The valve fitted on this vent line should always be kept cracked off its seat to allow part of the water and any accumulated air to escape.

In order to remove as much oil and grease as possible from the water before it enters the boiler, some ships are fitted with feed water filters. The number of devices for this purpose are large, but nearly always a filter tank is used, consisting of several compartments at the top, each connecting to the other through perforated plates. In these chambers are placed the filtering material, which usually is some fibrous material, such as loofa sponges, excelsior, bagging, etc. These materials collect the oil, grease and impurities. When they become badly fouled, they can be removed and washed or renewed. Generally the discharge of the air pump leads into these filter tanks, and they drain to the feed tank.

Grease extractors are sometimes fitted to the feed lines. These consist of a vessel that forms a part of the line, this being fitted with a bypass around it. In this vessel is fitted a perforated cartridge or cylinder, over which is wound and sewed Turkish toweling covering; this takes up such grease and oil, etc., that gets by the filter tanks.

The salinity test of the boiler feed water will indicate whether or not any considerable amount of solids are being introduced into the boiler. To ascertain the amount of grains per gallon in the water used the B. & W. test has proven most popular with many engineers.

A graduated bottle or test tube designed to be used with chromate indicator and silver nitrate solution is used in making the test. The bottle of silver solution is made up of 4.738 grams of silver nitrate to 1,000 grams of pure distilled water. The chromate indicator is a 10 percent solution of pure potassium chromate.

Testing Water for Corrosiveness

The test is made as described in "Marine Steam," by filling the graduated bottle, Fig. 1, to the zero mark with the water to be tested. Add one drop of the chromate indicator, then slowly add the silver solution; keep shaking the bottle. On nearing the full amount of silver solution required, the water will turn red for a moment and then back to yellow again when shaken. The moment it turns red and *remains red,* stop adding the silver. The reading on the graduated bottle at the level of the liquid will show the amount of chlorine in grains per gallon. For example, if a permanent red color is shown when the level is midway between 150 and 200, there are 175 grains of chlorine per gallon.

The principle of the process depends upon the fact that if some of this silver solution be dropped into water containing a chloride, a curdy white precipitate of chloride of silver will be formed. If there is also present in the water enough potassium chromate to give a yellow color, the white precipitate will continue to form as before, owing to the silver having a greater affinity for chlorine than for the chromic acid in the chromate. But, at the moment when all the chlorine in the sample has been converted, the silver will attack the yellow potassium chromate, and chromate of silver will be formed, which is red in color. The amount of chlorine present is, therefore, shown by the amount of silver solution required to convert it all to silver chloride, and the determination of the exact point at which the chloride precipitate ceases to form is greatly facilitated by observing when the chromate indicator turns from yellow to red.

It is not necessary to add the silver solution until the color becomes very red, as the delicacy of the reaction would be destroyed, but the change from yellow to yellowish red must be distinct and must not change on shaking. The sample of water to be tested should be neutral, as free acids dissolve the silver chromate. If it should be acid, neutralize by adding sodium carbonate. Slight alkalinity does not interfere with the reaction, but should the sample be very alkaline it may be neutralized with nitric acid.

Should it happen that the color does not change within the limits of the graduations, the sample may be tested by diluting with distilled water. For example, add three

parts of distilled water to one part of the sample. If, then, on testing the mixture, the color changes at 200, the number of grains per gallon in the original sample will be four times this reading, or 800 grains.

The chlorine should be kept down to the least possible amount—say below 50 grains per gallon—as the nearer the boiler water is to fresh water, the safer the boilers are against corrosion.

As a general rule, when sea water is being unavoidably allowed to enter the feed water used for the boilers, blowing down should not be resorted to until the saturation test shows an excess of 600 grains of chlorine per gallon in firetube or B. & W. boilers, 300 grains in Niclausse boilers, and 150 grains in small bent-tube or torpedo boat boilers.

If the water is so corrosive as to be acid, blue litmus paper, which has not been allowed to deteriorate through exposure to the atmosphere (keep in a bottle with a glass stopper), will turn slightly red. If a change in color is not apparent at once, it should be allowed to remain in the solution a few minutes and then carefully dried and compared with an unused sample.

Another method is to put into it a few drops of a chemical called methyl-orange. This methyl-orange gives a yellow color so long as the water is alkaline, but if turned pink it shows that the water is acid and therefore highly corrosive. The latter test is more sensitive than the litmus paper test, and should be used in preference.

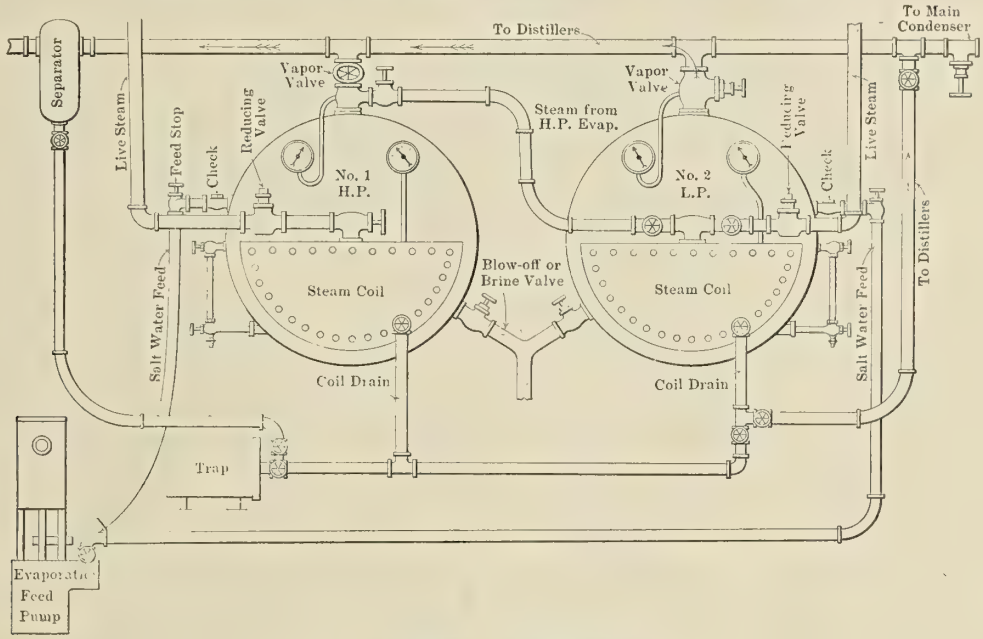


Fig. 3.—Multiple Effect Evaporator

EVAPORATORS

The working of an evaporator is practically the same as a boiler. The water in an evaporator is heated by steam coils, whereas in a boiler it is done with hot gases. There are several types in use, but all are designed on the same principle. The latest type is that of the Reilly multicoil; in this the heating is done by a series of coils, each one of which is detachable by breaking a union joint at each end. The big feature of this is their accessibility for cleaning of scale to make repairs.

The operation of a single evaporator is as follows: The shell is filled to the top of the coil. The vapor valve on top of the shell is closed, and then steam is turned into the heating coil, the drain of which is opened to the trap. While the pressure of the shell is building up, the distillers are made ready by starting the distiller circulating pump and opening the condensate discharge valves to the distilled water measuring and testing tanks.

When the steam pressure has built up to 10 pounds, the vapor valve is carefully cracked open. The main thing about pressure of the coil and shell is to so regulate the two that no priming or foaming will result, and yet obtain capacity. This varies according to the length of time the coil has steamed without cleaning the salt scale. In practice, 40 to 50 pounds gage pressure on the coil will give 10 to 15 pounds on the shell.

To prevent priming, general experience points out that the water of the shell should be carried below the first two rows of tubes or coils, so that the bubbling water will come in contact with these exposed tubes and flash into steam. It must be kept in mind that salt water tends to foam more violently than fresh water. In feeding, the feed stop should be regulated to keep the water level constant. A string tied on or some mark made at the correct height on the gage glass helps to keep it so. Owing to its high evaporative power, an evaporator will prime unless handled carefully.

When the distillers first discharge the water to the measuring tanks, it is there tested with silver nitrate as to its freshness. Generally, on starting of an evaporator, the first hundred gallons will run slightly salt. This is not fit for use on the boilers, but on some ships it is pumped into the crew's washroom tanks, or a water tank which is used for ship cleaning work. When the water comes fresh, it is measured, and then pumped or run to the reserve bottoms, or storage and trimming tanks.

It is advisable in operating to brine off—that is, to blow down the evaporator once every four hours. To do this, the vapor valve is closed and the shell pressure allowed to build up to 30 pounds, then the steam of the coil is shut off. The blow-off valve is slowly opened to full open and the shell is allowed to blow empty.

This carries out all the heavy brine and small lumps of salt scale, and is the best method to use. Some engineers prefer to blow down just a little each hour, but if the evaporators are required to be used steadily, the complete blow down method, coming at the end of each four-

hour watch, gives the steaming watch below a chance to clean fire while the evaporators are shut off for brining.

Fig. 3 shows the layout of piping for compounding two evaporators. The high-pressure evaporator, No. 1, uses live steam in its heating coils, and the vapor valves of the distiller line are so regulated that the vapor of this No. 1 high pressure evaporator is directed into the coils of No. 2, the low pressure evaporator, and after passing through the coils of this, it is then directed to the distillers. The object of this scheme is to get more distilled water per pound of coal used.

In operating in double effect, the coil pressure of the high pressure is carried at about 80 pounds; this gives about 45 pounds on the shell, and in turn we get the reduced pressures for the low pressure evaporator. The piping is so flexible in arrangement that both evaporators can be operated as high pressure or single effect.

In some evaporator plants there are fitted filters for the distilled water, and the feed pumps supply the evaporators through feed heaters, but general practice is to have the feed pump take its suction from the overboard discharge line of the distiller circulating water, which is quite warm.

It is economical to keep some water in the lower part of the evaporator steam coils. When running in single effect, this insures using all the heat of the steam and not bleeding live steam into the traps.

The evaporator coils will have to be removed at regular intervals for freezing of the salt scale, generally after 500 to 700 hours of use. Before removal, a large amount of the scale can be cracked off by filling the shell with cold water and allow to stand until the coil is cold to the touch. Then, as quickly as possible, admit live steam to the coil to 40 or 50 pounds; this produces sudden expansion, due to the rapid changes of temperatures of the coils, and cracks off a lot of the salt scale. There is but one drawback—it is apt to cause leaks in the joints if they be in poor condition. The shell is drained and the coil pulled out, then with scaling tools the balance of the scale is removed.

Coils should be tested, when out for cleaning, as to their tightness. When the boiler steam leaks into the shell space through leaky coils, if drinking water is being made, it becomes tainted with oil or boiler chemicals carried in the steam.

Forced Draft

There are several systems of forced and induced draft in marine use. The two which are most extensively used are the closed ashpit and induced draft, popular for fire-tube boilers, and the closed fireroom system used on many ships fitted with watertube boilers and many of the vessels of the navy.

Under normal steaming conditions, natural draft with all boiler power is best and most economical to use, but when the boiler power is reduced (such as when a part of the boilers are disabled for repairs or overhaul, or when there is a demand for increased speed above the regular standard capable with natural draft), the application of forced draft is a necessity. Some vessels are designed to operate at all times with induced draft, or the closed ashpit system.

A brief description of the two systems is given to acquaint the newcomer with what he may expect to meet with in working under them.

Closed Ashpit System

Large centrifugal fan blowers are so located that the air is delivered through a special heater installed in the uptake to a series of ducts that lead to the ashpits, which are tightly closed.

When charging the furnaces, the draft is cut off to prevent the flame and gases of the furnaces being forced out the fire door into the fire-room. The furnace and ashpan doors are fitted with automatic locking devices that take care of this.

The supply of air or pressure is regulated by varying the speed of the blowers and the thickness of the fuel bed. There is also fitted at the back of the ashpans a damper to be used in closing off the ashpit duct when operating under natural draft.

The Howden system uses retarders in the fire tubes—they consist of spiral-twisted thin metal strips that are inserted easily into the ends of the tubes. These insure the hot gases giving up all the heat by causing them to travel in spiral contact, thus retarding their egress.

All the air ducts and boiler casing must be frequently tested for leaks of the air pressure into the fireroom. Considerable saving is made by keeping these tight.

Induced Draft

In this system there is fitted in the base of the stack an exhaust fan that draws a current of air upward through the airs; it also uses closed ashpits, drawing the air, as in the previous system, through air heaters by means of ducts. The chief difference in these two systems is that the induced draft has no attendant danger of flarebacks when firing, as the air is drawn through the fire instead of being forced, as in the Howden system; also there is less trouble with leaks in the ducts and casings.

Closed Fireroom System

This is in general use on vessels of the navy, and has many inconveniences. All openings into the boiler room must be closed, for the air is discharged direct from the fan blowers into the fireroom. The only outlet for the air pressure is through the furnaces. In using this system, no changes are necessary to be made in the boiler to shift from natural to forced draft, but attention is required to get the fireroom ready. All hatches and doors are closed and dogged; all openings of the louvres of the bunkers used for vents must be closed.

In steaming with forced draft, the fires must be carried about 3 inches thicker than under natural draft. The rate of evaporation is much higher, and this calls for strict and careful attention in tending the water level. It should be two inches higher than for natural draft. Clinkers will form more quickly and plentifully, due to the increased coal consumption. It is therefore advisable to keep a small amount of water in the ashpans. The temperature of the fireroom is higher than under open conditions, and the men will find it harder to work under the air pressure. When the coal is fine and dusty, it will be to advantage to sprinkle it down before firing; this prevents it blowing around in the fireroom, and saves a large percentage from being carried up the stack.

To measure the air pressure created by the blowers, a draft gage is used, as shown in Fig. 2. The gage is of glass and is filled with water to the zero mark. One leg is open at the top to the pressure of air in the firerooms; the other is connected to a pipe leading to the atmosphere outside the firerooms. The difference in pressure is read in inches of water on the scale of the draft gage. For example, if the water is depressed one inch in *A*, and rises one inch in *B*, then the air pressure is two inches of water. One inch of water pressure is equal to two-thirds ounce pressure per square inch.

The writer finds it pays to wear goggles over the eyes while working in closed firerooms under forced draft.

The Service Department of a Shipyard*

Development of Service Department at Fore River Shipyard—Its Personnel and Functions—Reduction in Turnover of Labor

BY SAMUEL W. WAKEMAN

THE object of this paper is to describe a method of handling certain phases of shipyard work which has been successfully tried out in one large Eastern plant. Although some of the functions of this department are probably being carried out in the different yards to-day, we do not know of anyone who has treated this problem in just this manner.

About two years ago the president of the plant became interested in the enormous number of men that it was necessary to hire each month in order to maintain the working force then needed to carry out the work in hand. He determined that this problem must be solved and a committee was selected from the plant, composed of workmen, foremen and others. They made a tour of the country, visiting the following manufacturing concerns: "Link Belt Company, Sherwin Williams Company, Jeffery Manufacturing Company, Cleveland Hardware Company, Curtis Publishing Company, Chalmers Motor Company, Cleveland Foundry Company, Goodyear Tire & Rubber Company, Cadillac Motor Company, National Cash Register Company, Dodge Motor Company, Packard Motor Company, Ford Motor Company, Westinghouse Manufacturing Company, Carnegie Steel Company.

The most courteous treatment was accorded this committee at each of the above-mentioned plants, and the fullest information was given by them on all of the points which this committee investigated.

Recommendations of Committee

On their return they prepared a report of their investigations, together with such recommendations as to the betterment of the then existing conditions as they thought should be made, these recommendations including such ideas as the centralizing of employment instead of allowing each one of the different department heads to carry this on themselves. It also recommended that a new building be erected for this purpose; that a different point of view be taken with regard to applicants for positions, namely, their treatment should be as courteous and as fair as was possible to be given; that the housing and boarding situation be investigated; that all men leaving the employ of the company should be interviewed and given a chance to air their grievances. They further recommended a great many lines of activities to be encouraged in the plant and touched on many lines that had to do with the physical, mental and social condition of the employees. The recommendations of this committee were printed in pamphlet form and sent to about two hundred people in the plant. They were asked to freely criticise and, if possible, to make further recommendations. All of this information was then collected and formed the basis for the policy which is being pursued at the present time in regard to the service work in this plant.

A brick building was erected near the main gates of the plant to take care of the hospital work, the employment department, and the general activities of that nature. These activities were grouped under the name of Service Department, which, as its name signifies, is to render service to the employees of the plant. This department was put under the supervision of the general superintendent of the plant. The scope of its activities is as follows: Employment, hospital, safety work, educational work, apprentices, employees' club, works paper, suggestion committee work, yard restaurant, shop training.

Personnel

The personnel of this department consists of the following: Supervisor, assistant, clerks, stenographer, supervisor of instructors, instructors, employment agent, employment clerk, doorman, doctors, nurses, messenger boys for conducting applicants to shops.

In order to see clearly the relationship between the Service Department and the superintendents and foremen in the yard in regard to the supply of labor, the following illustration is used:

The ship carpenter may want ten pieces of 12-inch by 12-inch yellow pine 30 feet long. His requisition comes to the purchasing agent, who buys this material and has the same delivered to the ship carpenter. If on inspection by him three or four pieces out of the ten prove defective, he condemns this material and the purchasing agent replaces it. The ship carpenter decides what class of work this lumber can be used for and decides also whether the price paid for it is justified.

Requisitions for Labor

The same procedure holds for the supply of labor. A foreman finds he will need a certain number of men at a given time. He sends his requisition for this labor to the employment division of the service department. They send the required number of men to the foreman after interviewing these men and weeding out, so far as is possible, such applicants as would be incapable of carrying out the work for which they are required. These men are sent to the foreman of the department, who takes or rejects whatever number he may see fit and rates those he keeps, and those he rejects are sent back to the employment department, where an effort is made to place them in some other department in the yard where they may find work which they can do.

If the men hired are not satisfactory to the foreman, he may discharge them. In no particular are any of the foreman's prerogatives in regard to the handling of labor taken from him. The advantage of this method, however, is that the foreman is not compelled to interview a large number of men who have no qualifications for the work he is supervising, and his time is conserved for the more important duties he has to perform.

Examination of Applicants

Each applicant for a position is put through a careful physical examination by the company's doctor, and only such men are employed as are capable of doing the work for which they are hired. This has resulted in getting a very good class of men, and, where slight physical defects are found which can easily be remedied, the man is sent to the proper medical authority and taken care of. At first there was considerable objection on the part of some

* Paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1917.

of the men, but at the present time practically no one objects to the physical examination.

The employment department keeps an up-to-date requisition of all labor requirements of the plant, and takes such steps as are necessary, through its various sources of supply, to keep this requisition filled. It attempts to learn, by keeping in close touch with the various departments, the probable future needs for labor, which is a vitally essential factor in keeping a steady flow of men into the yard.

All applicants for work are quartered in a waiting room in the service building, equipped with chairs, and are interviewed in turn by the employment agent, being given a private interview in a separate room.

Book of Information for New Employees

Each applicant when hired is given a book which contains all the information about the plant that it is considered a new man should have. This book has been carefully prepared and gives the hours of labor, the method of tool delivery, certain safety suggestions, times and methods of payment of wages, and, in general, information in a condensed form which the new employee generally gets only after long association in the plant. This book has proven to be a great help to new men coming into the plant.

All employees transferred or leaving the employ of the company are required to be interviewed by the employment agent before they can obtain their wages. This provides an opportunity to place the man in a department where he may fit to better advantage than the one in which he was working, and also gives him opportunity to state any grievances he may have in connection with the company, his foreman or his work. These grievances are carefully tabulated and looked into and have been found to be a great source of valuable information in connection with controlling the feeling the employees have toward the company. All records for present and past employees are filed alphabetically in the employment bureau, and these records contain the name, age, trade, physical qualifications, address, place of past employment, rate, etc.

Daily Reports of Employment Department

There is a daily report prepared by the employment department, showing the number of men hired and leaving by trades, also daily gain or loss in the working force. The department also makes a monthly report of the turnover of labor, including the number of men hired and leaving by trades, showing the length of service and reasons for the man leaving.

One of the most important phases of the employment work is to provide proper housing facilities, and to this end the employment department lists, for the information of all applicants, boarding houses and available houses for sale or for rent.

If there is no position open at the time the applicant applies in person or by letter, an application card is filled out and filed by trades. All applications for employment are filed, and, as far as possible, the applicant is informed as to what date his services will be required, giving the minimum and maximum rate for the trade desired and the hours of labor.

Under the service department is a competent surgeon and an up-to-date hospital, where all of the accident cases in the yard are treated. The families of the employees may obtain free medical attention during certain hours of the day.

The safety work in the plant, which had reached a fair state of development, was combined with the work of the service department, and the different shop committees, together with the General Safety Committee, use this building as a meeting place where frequent talks by men who are specialists along this line of work are given to these men. Each department has its own safety committee, which makes periodical inspections and reports directly to the General Safety Committee. A great many ideas for work of this nature have originated in these committees and numerous appliances and safeguards have been adopted, due to suggestions received from them. All accidents are carefully investigated and the causes are immediately remedied; responsibility for accidents, as far as possible, is placed and steps taken to rectify them.

Educational Work

All of the educational work in connection with the training of apprentices and the training of men in the shops and different departments throughout the yard have been placed under the jurisdiction of the service department.

During the winter months, evening schools are conducted which provide training in naval architecture, moldloft work, plumbing, coppersmith work, machine shop design, mathematics and blueprint reading. The instructors for these evening classes are, for the most part, drawn from the various departments in the yard and the instructions carried out under the direction of the local school board. These classes are open to any male beyond the age of sixteen in this locality and are attended by mechanics, apprentices and helpers to the number of about two hundred.

Apprentice Training

All of the work in connection with the apprentices in the plant is carried out under the supervision of the foremen in the different departments, but along the lines as laid down by the educational part of the service department, and the head of this department has been very successful in this connection with the attitude of the apprentice toward the company. Each year a dinner, to which prominent officials of the company are invited, is given by the apprentices, and efforts are made to promote the best of feeling among the young men who are being trained for future service in the company.

The service department supervises the publication of a works paper, which is issued every three months by the employees. This paper has developed to such an extent that its issue is awaited with a great deal of interest by all of the men in the plant.

Club House

The company presented to the employees of the plant a club house equipped with bowling alleys, rifle range, assembly and dancing hall, pool table, a band room and an athletic field where the different athletic teams practice and have their games. Quarters are provided for the athletic teams of the company in this building, with suitable shower baths, etc. This club is run entirely by the employees of the company, and only such necessary supervision is given to it by the service department as is absolutely necessary.

A restaurant is maintained inside the plant for the benefit of the employees. The supervision of this restaurant, although run by an outside caterer, is left to a committee of the employees who are in close touch with the service department.

Suggestion Boxes

One very important part of this service department work is the handling of the suggestions sent in by em-

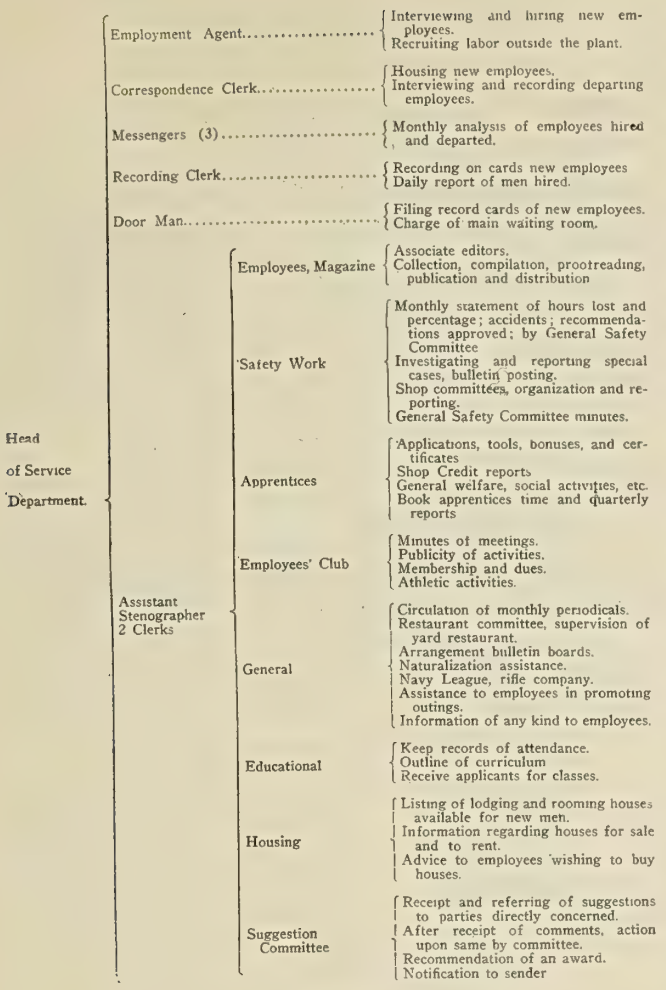

Head of Service Department
Employment Agent
Interviewing and hiring new employees.
Recruiting labor outside the plant.
Correspondence Clerk
Housing new employees.
Interviewing and recording departing employees.
Messengers (3)
Monthly analysis of employees hired and departed.
Recording Clerk
Recording on cards new employees
Daily report of men hired.
Door Man
Filing record cards of new employees.
Charge of main waiting room.
Assistant Stenographer 2 Clerks
Employees, Magazine
Associate editors.
Collection, compilation, proofreading, publication and distribution
Safety Work
Monthly statement of hours lost and percentage; accidents; recommendations approved; by General Safety Committee
Investigating and reporting special cases, bulletin posting.
Shop committees, organization and reporting.
General Safety Committee minutes.
Apprentices
Applications, tools, bonuses, and certificates
Shop Credit reports
General welfare, social activities, etc.
Book apprentices time and quarterly reports
Employees' Club
Minutes of meetings.
Publicity of activities.
Membership and dues.
Athletic activities.
General
Circulation of monthly periodicals.
Restaurant committee, supervision of yard restaurant.
Arrangement bulletin boards.
Naturalization assistance.
Navy League, rifle company.
Assistance to employees in promoting outings.
Information of any kind to employees.
Educational
Keep records of attendance.
Outline of curriculum
Receive applicants for classes.
Housing
Listing of lodging and rooming houses available for new men.
Information regarding houses for sale and to rent.
Advice to employees wishing to buy houses.
Suggestion Committee
Receipt and referring of suggestions to parties directly concerned.
After receipt of comments, action upon same by committee.
Recommendation of an award.
Notification to sender

Fig. 1

ployees. Boxes are placed throughout the yard and prizes are offered for suggestions sent in by the men. There is a great deal of work in connection with the proper understanding of what the employee means, the making of sketches, the referring of these suggestions to the proper people, so that they may be acted on, and the attitude which the men have toward this phase of the work must be carefully handled in order that the greatest amount of good may come from it. The work of this committee, of which the head of the service department is chairman, is one of the very important functions of this department.

Turnover of Labor

All of this work has begun to show results which it is felt can directly be traced to the work of this department. Statistics for many of the large manufacturing plants throughout the country that have attempted to increase their working force have shown that it is necessary to hire anywhere from seven to ten men in order to obtain one permanent employee. The latest results here have shown that it has been necessary to hire two men instead of from seven to ten in order to obtain one. When you consider that it is estimated that it costs somewhere between $20 and $35 to hire a new employee the result of cutting down the turnover in any plant means a tremendous saving in dollars and cents, although it may not always be possible to directly measure this.

Much of the reason for this decrease in turnover can be credited to the selection on the part of the service department; the hearty co-operation of the foremen, who have allowed a very liberal system of transfer from one department to another; the training of men into trades which they were not familiar with, and, in the main, to the general broad policy of the man directing the company.

Before the above plan was in operation, in order to maintain a force of about 4,000 employees, it was found necessary to hire, in the course of a year, 8,000 men. During the last six months the present force has been increased from 4,000 to 8,000, and this has been done by hiring 9,000 men. While these results cannot all be attributed to the work of this department, nevertheless it is felt that, in a large measure, the work which has been accomplished by them is responsible for a large percentage of this showing.

It is not claimed that any new or radical ideas have been adopted in connection with the handling of this situation, but what has been done is to find out what successful concerns in other lines of work have done and to combine them together in such a way that they might be adapted to the work of a shipyard. A man was employed who was thoroughly familiar with the sources of labor supply in the district in which this plant is located, and much credit is due him for the enthusiasm with which he approached this difficult problem.

An outline diagram showing the relationship of the different functions of this department to each other is shown in Fig. 1.

Tests of Oxyacetylene Welded Joints in Steel Plates

A series of tests of the strength of oxyacetylene welded joints in mild steel plates has been completed by the Engineering Experiment Station of the University of Illinois under the direction of H. F. Moore, Research Professor of Engineering Materials. Specimens were supplied by the Oxweld Acetylene Company of Chicago and tests were made in the laboratories of the station at Urbana under three conditions of loading: (*a*) static load in tension (in a testing machine), (*b*) repeated load (bending), and (*c*) impact in tension (in a drop testing machine).

For joints made with no subsequent treatment after welding, the joint efficiency for static tension was found to be about 100 percent for plates one-half inch in thickness or less, and to decrease for thicker plates. For static tension tests, the efficiency of the material in the joints welded with no subsequent treatment was found to be not greater than 75 percent. The joints were strengthened by working the metal after welding and were weakened by annealing at 800 degrees C. For static tests and for repeated stress tests, the joint efficiency sometimes reaches 100 per cent; the efficiency of the material in the joint is always less. This indicates the necessity of building up the weld to a thickness greater than that of the plate. The impact tests show that oxyacetylene welded joints are decidedly weaker under shock than is the original material; for joints welded with no subsequent treatment, the strength under impact seems to be about half that of the material.

In general, the test results tend to increase confidence in the static strength and in the strength under repeated stress of carefully made oxyacetylene welded joints in mild steel plates.

The results of these tests have been published as Bulletin No. 98 of the Engineering Experiment Station, copies of which may be obtained without cost by addressing C. R. Richards, Director, Urbana, Ill.

Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Loose Crank Pin

I noted with interest the way in which Andrew Lan, on page 511, the November issue of MARINE ENGINEERING, made his loose crank pin repair. It reflects credit on those who worked it out. The writer has, in several instances, dealt with the same trouble in a somewhat different way, and is passing this information along, not as new and original, but as old, and which may be of value to the younger engineer's notebook.

The center of the loose pin is drilled out and reamed tapered (a slow taper) to near full depth of the pin in the web, and a forged machine steel-tapered pin is then

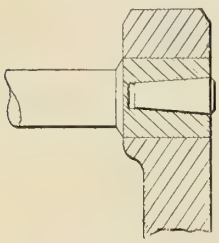


Fig. 1

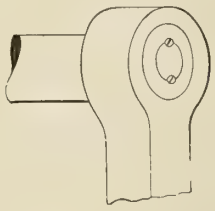


Fig. 2

driven, as shown in Fig. 1. The web and crank, contrary to belief, is not heated. The tapered pin is driven into it cold, and when it refuses to go any farther with square, heavy blows, it is cut off and doweled with screws on the face, as in Fig. 2.

The last repair made to a loose pin by the writer was nine years ago, to an 8-inch pin. A 2-inch hole was drilled, and a Morse standard taper reamer was used. The job is still running tight to-day.

Concord, N. H. CHAS. H. WILLEY.

An Understudy

Look about you for the youngster that's in love with the engineer and the plant—always grimy and dirty and happy—always glad to be called upon to help. He wants to be a real engineer—has always, from a kid. It's up to you, chief, to remember how you wanted a chance to learn when you started. When you see him, give him encouragement, take him in tow, give him a helping hand, and share with him your hard-earned kinks and experiences. Don't let him blunder along the hard road when you can set him right by a word or two. Discipline him when he needs it in a firm, kind way.

If there is such a young man in your plant, chief, make him an understudy, and do it earnestly. There will be a deal of satisfaction in feeling that you have trained such a youngster along the right path. Perhaps as the years pass by, he will do you great credit, and with the encouragement that you have given him he may become imbued with a stick-to-it spirit and desire to be a better engineer than his fellows. He may even aspire to fill the superintendent's or general manager's position of the fleet. His kind generally follow their ideal with unflinching zeal and eventually get there. You, then, chief, have a right to point to him and say: "See that young man filling the general manager's chair. Well, he used to be my understudy. I gave him a right start, and he's made good."

OBSERVER.

Lock Nuts

A few lock nuts that will be found handy for securing nuts of piston followers, cylinder heads, valve chest covers, etc., are shown in the illustrations. While these are not original with the writer, they are passed along for their worth.

Fig. 1 is a simple form. A slot is cut at the lower edge of the nut, and a prick punch impression is made on

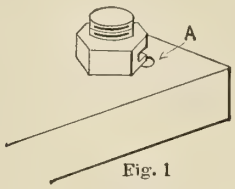


Fig. 1

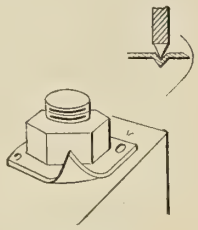


Fig. 3

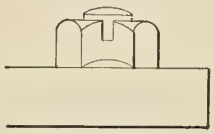


Fig. 2

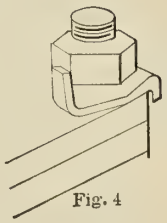


Fig. 4

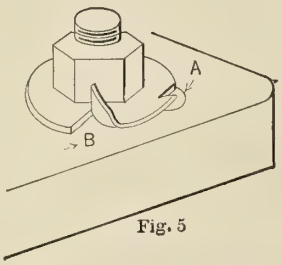


Fig. 5

Various Types of Lock Nuts

the machine, as shown at *A*. When the nut is tightened up home, the edge of the slot is bent down into this impression, thus securing the nut.

Fig. 2 shows the nut slotted at the top, and a radius filed on the bottom. When tightening down this nut, this radius at the bottom tends to flatten, thus closing the slot at the top, which pinches the stud.

Fig. 3 is a simple form of lock washer. A piece of flat stock is used as shown. When the nut is driven home on this washer, one corner is turned up flat against the side of the nut and the other corners are prick-punched deeply into the machine surface, as shown.

Fig. 4 is adaptable for corner or edge studs. A piece of flat stock is used for a washer. One edge is bent up against the nut, and the other edge bent over or down, as shown.

Fig. 5 is a common washer. A hole is drilled in the machine at *A* about 1/16-inch deep and ¼-inch diameter. The edges of the washer are turned up at *B* and down at *A* into the hole, thus securing the nut from turning.

MACHINIST MATE.

Packing Notes

High grade sheet packing is expensive stuff, and if waste of this can be prevented by the engineers, they will find that economy here receives a big boost. It pays to use the best packing obtainable, and suitable to the needs. In selecting a packing, there is but one kind to use, and that is the kind advertised in the trade journals as having stood the test. At the present time there is an abundant supply of varieties of packings, each one, of course, claiming the blue ribbon. It has always been true that wherever the price is low the standard value of quality is also lowered.

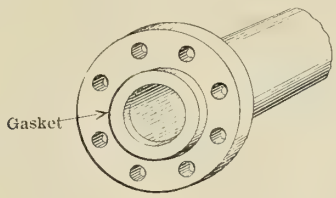


Fig. 1

There appears to be much chance for saving in packing expenditures on board the average ship, for where data were obtainable the packing expense was very excessive. Perhaps the largest source of waste, and the easiest prevented is that of allowing every Tom, Dick and Harry to cut out a gasket. It is safe to say that more than 50 percent of ship's engineers allow coal passers and firemen, when they are being used as helpers on repair work, to do so. These men usually have no idea of packing values, and they hack out a gasket most any old way, wasting considerable by improper laying out and cutting.

When the flange of a joint is of sufficient width or face inside the bolt circle, much material is saved and a better joint made by cutting the gasket to fit, as shown in Fig. 1.

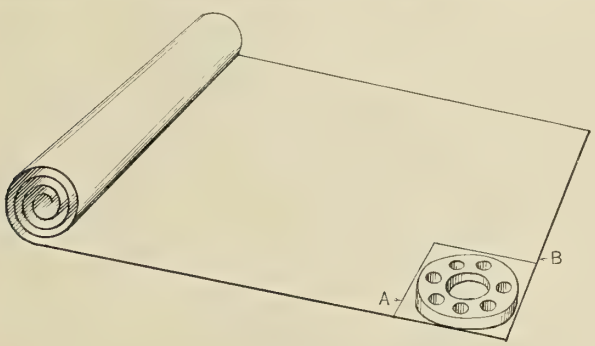


Fig. 2

When tightening up on such a gasket, the full strength of compression is exerted upon it, whereas in a full face one, that portion outside of the bolt circle often has to be squeezed thin by extra force on the bolts in order to make a tight joint.

Fig. 2 shows the best way to lay out a gasket. A template of the flange is laid on the packing and its outline scribed. The template should be placed as shown, as close to the edges of the sheet of packing as possible. Fig. 3 shows a large cylinder head gasket; the center section of

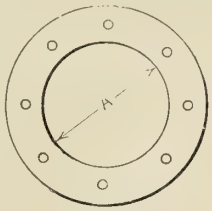


Fig. 3

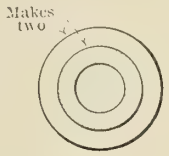


Fig. 4

Fig. 5

this at *A* can be saved to make smaller gaskets, as in Fig. 4.

Many men waste packing when cutting from these circular pieces, as shown in Fig. 5. When making square

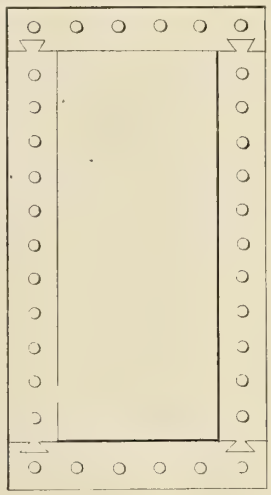


Fig. 6

or rectangular shaped valve chest cover gaskets, the narrow strips that would be otherwise wasted can be cut as shown in Fig. 6, dovetail at the ends. The dividers and rule are very reliable in the hands of a good man for laying out circular gaskets. But when a template can be had, it is the best method to use.

Fig. 7 shows the old and much abused method of marking out with a ball peen hammer an impression of the

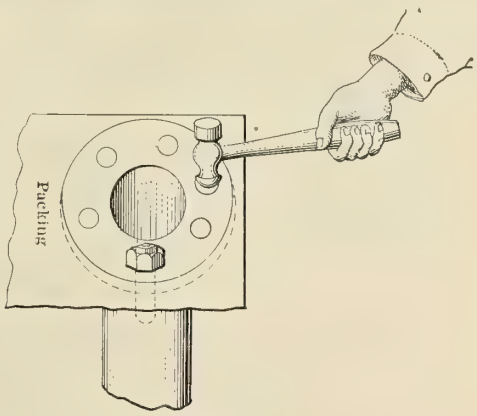


Fig. 7

joint flanges. A very good facsimile of the flange and bolt holes can be made in this manner, and then the gasket cut with proper tools on a block of wood. It is dead wrong to hack out expensive packing with a hammer over the edges of a flange. Such a method is only justified

when rush emergency work makes this quick method essential.

Fig. 8 shows a gasket with two ears or tabs left in cutting for the purpose of aiding in inserting the gasket in place between tight flanges in close, hot and uncomfortable quarters. These ears are made by leaving the corners *A* and *B*, in Fig. 2, a part of the gasket.

Fig. 9 is another method of inserting the gaskets in tight places. Often there is a leak in a valve of the line,

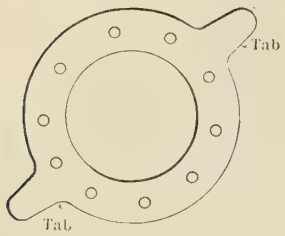


Fig. 8

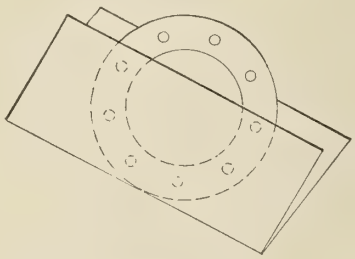


Fig. 9

and it is next to impossible to work next to the joint with one's hands. A thin sheet of paper brass, bent as shown, will pass through the joint, and as the upper part of the gasket gets in place, a bolt is slipped through the hole, and this holds it in place while the brass is withdrawn.

Fig. 10 is a sketch of a very handy gasket saw. The frame is made of pipe, flattened and bent, as shown. The

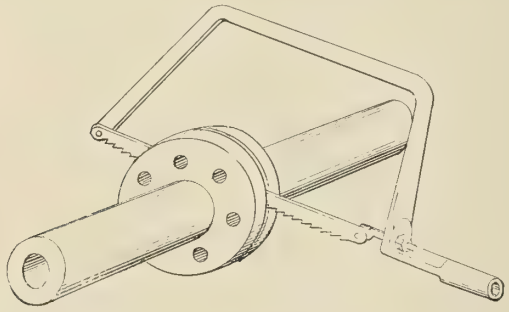


Fig. 10

purpose of this saw is to tear out the old gasket that always adheres like glue to the flange faces. After the saw clears the way, then a packing knife or scraper, made of an old hack saw blade, is used to clean the faces of the joint, one of which is shown in Fig. 11.

Fig. 12 shows very handy gasket trimming and cutting tool easily made from old files. Fig. 13 shows a die and

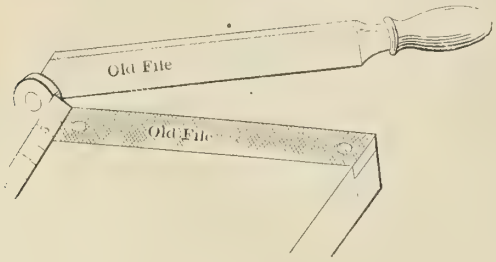


Fig. 12

punch made of an old round file and piece of machine steel. The bolt holes are cut clean at one blow when cut with such a tool. Fig. 14 is a cow mouth, or gouge chisel used to cut round corners, etc., made from a short piece of an old 14-inch flat file. The cow mouth shape is forged on the horn of the blacksmith anvil.

Sometimes one runs across a stubborn joint that, in spite of considerable attention, will leak or blow out. This kind of joint requires care and patience to make it tight. If ordinary packing does not hold, then the flange should be tested for trueness, and, if possible, a groove should be cut in the face of the flange into which the packing will squeeze, making it a male and female type of joint.

The most troublesome joint that the writer had to deal with in his experience was that of a high pressure feed water heater head. This head pulsated at each stroke of

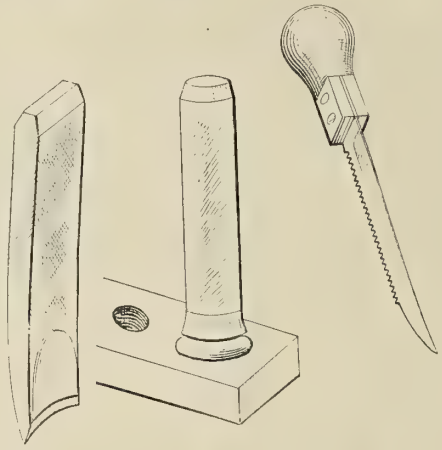


Fig. 14 Fig. 13 Fig. 11

the feed pump, and in spite of reinforcing with stays it would continue to throb and cause the joint to leak. After trying all the various thicknesses and kinds of packing, and having no luck, we resorted to making the joint with two thicknesses of fine brass wire mesh, coated on both sides heavily with red lead and litharge. This surprised us by holding tight, after allowing it to set. The main objection to this sort of gasket is the trouble experienced in breaking the joint when necessary to do work on the machinery.

Concord, N. H. C. H. WILLEY.

The Liberty Mill

(*Concluded from page* 33.)

ments is completed, the method of heating will be by by-product gas from the Clairton coke ovens in conjunction with a small quantity of tar.

The mill rolls plates up to 100 inches wide and 3/16 inch up to 2 inches thick. It rolls from slabs and sufficient steel for it is not available at present from the Homestead furnaces. The slabs come from Farrell Steel Works & Furnaces, Ohio Steel Works & Furnaces and Donora Steel Works & Furnaces, together with such miscellaneous slabs as can be taken from the present Homestead slabbing mills.

The best production to date is 266 tons, single turn, ten hours, with six furnaces. With an ample supply of steel and orders of a character suitable for maximum production, it will make 16,000 tons per month.

The cost of the mill will approximate $2,500,000 (£512,500), including therein the cost of the new gas engine, generator, etc., at Carrie Furnaces. On double turn it will employ approximately 250 men.

The average number of men employed under Homestead Steel Works organization in October, 1917, was 12,132, and the production of steel ingots was about 200,000 tons. This is not the maximum production for this plant. Tonnage has been reduced by reason of transportation difficulties, lack of coke, labor, etc.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

There will appear in this column from time to time questions which have been asked by the Board of Steamboat Inspectors in the various examinations for engineers' licenses conducted by them. Such questions will be denoted by an asterisk (*) placed before the number if from examination for grade of chief, and by a dagger (†) if from examination for other grades.

Stephenson Link Motion

Q. (929).—What is the difference between the two arrangements of Stephenson link valve gear known as open and crossed rods? When either type of link is used with an outside valve, what are the effects of linking up upon angular advance, valve travel and lead?

A. (929).—A Stephenson link valve gear is known as an open gear, or gear with open rods, if when the crank is turned away from the cylinder the rods are open as

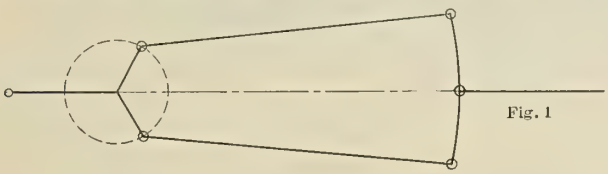


Fig. 1

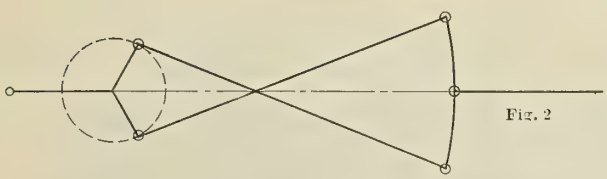


Fig. 2

shown in Fig. 1. A Stephenson link valve gear is known as a crossed gear, or a gear with crossed rods, if when the crank is turned away from the cylinder the rods are crossed as shown in Fig. 2.

Effect of linking up:

	Open Rods	*Crossed Rods*
Angular advance	Increased	Increased
Valve travel	Decreased	Decreased
Lead	Increased	Decreased

The above effects are produced when an outside valve is used. When used with an inside valve, lead is the only characteristic of those under discussion affected, and it is decreased and increased respectively for open and crossed rods.

Piston Valves

Q. (930).—What is the chief advantage of the piston valve over the flat slide valve? When are piston valves employed?

A. (930).—The great advantage of the piston valve over the flat slide valve lies in the fact that it is perfectly balanced as regards the steam pressures which act upon it, and, therefore, moves with only such frictional resistance as may be necessary to insure tightness against steam leaks.

Piston valves are used when the steam pressures in the valve chests are high; with this type of valve the frictional load is less than with the flat slide valve. The high pressure and intermediate pressure cylinders of a triple expansion marine engine are usually fitted with this type of valve, and very frequently it is also the case with the low pressure cylinder.

Saturated Saline Solution

Q. (927).—With a solinometer at 12/32ds, will it rise any more?

A. (927).—The salinometer will not indicate a greater reading than 12/32, because at this density (really at 10/32) the liquid is a saturated solution. Any additional saline matter will not go into solution, but will be deposited.

Radial Type Valve Gear

Q. (933).—What are the chief advantages of the radial type of valve gear?

A. (933).—The chief advantages of the radial type of valve gear are: The length of the engine as a whole may be less than with the Stephenson link, as the cylinders may be placed near together, they possess the property of giving the same lead for all points of cut-off.

Effects of Changes in Valve Gear

Q. (934).—Explain the influence on the various events and items due to change in the three items, angular advance, steam lap and exhaust lap.

A. (934).—The answers to this question may be determined from the table:

Angular Advance	Increase	Decrease				
Steam Lap			Increase	Decrease		
Exhaust Lap					Increase	Decrease
Steam Opening	Earlier	Later	Later	Earlier		
Steam Closure	Earlier	Later	Earlier	Later		
Steam Lead	Increase	Decrease	Decrease	Increase		
Exhaust Opening	Earlier	Later			Later	Earlier
Exhaust Closure	Earlier	Later			Earlier	Later
Exhaust Lead	Increase	Decrease			Decrease	Increase
Greatest Port Opening	Same	Same	Decrease	Increase		

Capacity of Coal Bunker

Q.* (938).—How many tons of soft coal will a bunker 26 feet by 3 feet by 5 feet 2 inches contain?

A. (938).—Assuming the bunker to be rectangular, its capacity is $26 \times 3 \times 5.17 = 403.3$ cubic feet. The average of a large number (328) of weighings of various American bunker coals gave 42½ cubic feet = 1 ton. Customary values for calculation are 43 and 44 cubic feet = 1 ton. Using the former we get the capacity of the bunker to be $403.3 \div 43 = 93.8$ tons.

Capacity of Rectangular Tank

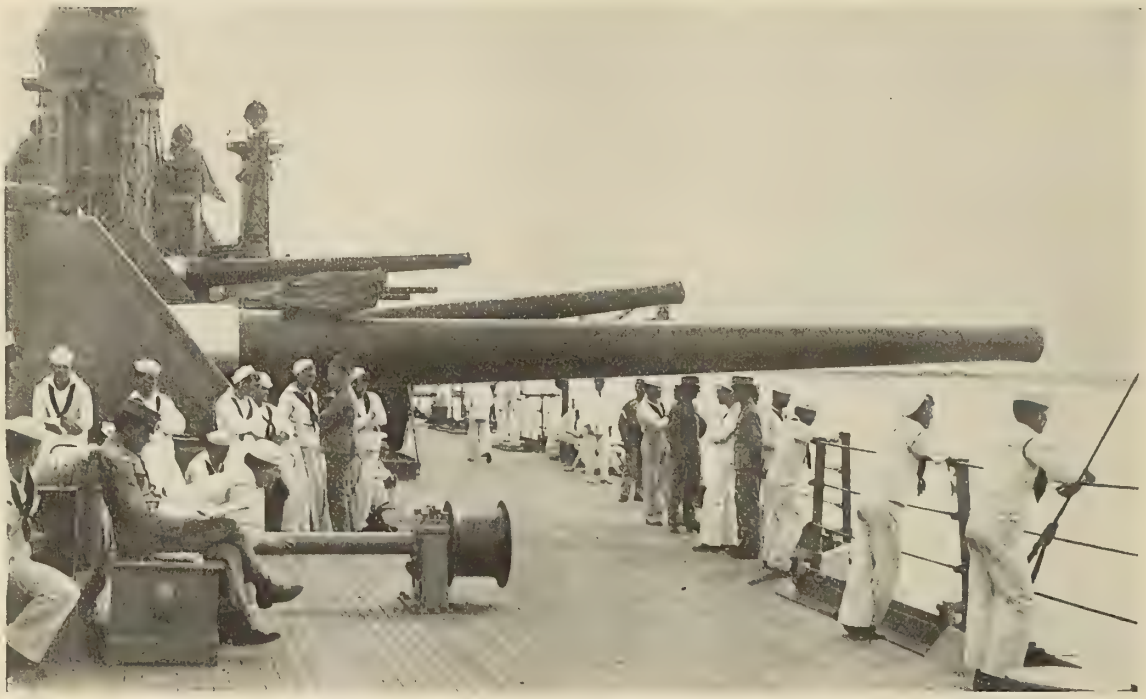
Q.* (939).—How many gallons of oil will a rectangular tank 3 feet 4 inches long, 32 inches wide and 5 feet 4 inches high contain?

A. (939).—The contents of the tank are $40 \times 32 \times 64 = 8{,}192$ cubic inches. There are 231 cubic inches in one U. S. gallon, therefore there are $8{,}192 \div 231 = 35.5$ gallons.

* Professor of Marine Engineering, Post Graduate Department, United States Naval Academy, Annapolis, Md.

ON BOARD A FIRST CLASS AMERICAN BATTLESHIP

Photographs copyright by Press Illustrating Service, Inc., New York



After Deck, Showing Main Battery

Physical Exercise Forms a Part of the Daily Routine of the Crew

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—Engineering Projects—Improved Appliances—Personal Items

CHAS. PIEZ NOW GENERAL MANAGER OF EMERGENCY FLEET CORPORATION

Resignation of Admiral Harris Causes Another Change in Organization

Charles Piez, vice-president of the United States Shipping Board Emergency Fleet Corporation, has been appointed general manager of the corporation, succeeding Rear Admiral F. R. Harris, who resigned shortly after his appointment to this post. It is now believed that the reorganization of the Emergency Fleet Corporation is nearly completed.

The appointment of Mr. Piez was made by Chairman Hurley with the object of speeding up the actual production of ships. Due to the fact that Mr. Piez had been head of the Production Committee of the Fleet Corporation, and had first-hand knowledge of the actual conditions in the yards as a result of careful study of conditions in the field, it is believed that the best results can be obtained by combining the functions of the vice-president of the organization with those of general manager.

Mr. Piez, who is about 51 years old, is a graduate of the Columbia School of Mines, New York City, class of 1889. His business and engineering career has been associated with the Link Belt Company, manufacturers of elevating, conveying and power transmission machinery, of which he has been president since 1906. In addition to personal and professional achievements, Mr. Piez has been very active in rendering public service. He was a member of the commission that developed the Illinois Factory Act in 1909, and the following year acted as chairman of the Illinois Workman's Compensation Commission.

New Building for School of Naval Architecture to Be Constructed at Massachusetts Institute of Technology

The Massachusetts Institute of Technology, Cambridge, Mass., is to begin at once the erection of the Pratt School of Naval Architecture and Marine Engineering building.

Charles H. Pratt, a Boston lawyer, left the bulk of his estate to the institute for this purpose, stipulating that the trustees should hold the fund until it amounted to $750,000. The fund now exceeds that amount by $100,000. The erection of the building has been deferred until this time on account of the high cost of materials and labor, but is now undertaken as a patriotic duty on account of the urgent demand for naval architects and draftsmen.

Shipbuilding Companies Consolidated

The Pusey & Jones Company, Wilmington, Del., has increased its capital stock from $1,250,000 to $20,000,000, and will take in the Pennsylvania Shipbuilding Company and the New Jersey Shipbuilding Company, which have adjoining plants at Gloucester, N. J. The three companies are largely owned and controlled by Christoffer Hannevig, 139 Broadway, New York, a Norwegian capitalist.

Are You the Man?

Skilled workers are needed at once in the air service behind the lines in France. Squadrons have been and are now being formed for this service. Picked men are being enrolled from the various workers; these men will be given special training, according to their vocations, in the work required in the air service. They will get actual practice work on airplane motors, trucks, airdome construction and everything that will be done on the other side.

If you operate a lathe, drive a truck, splice insulated wire, fit a joint, or do other skilled work better than the average—perhaps you are the man! Skilled men will be enrolled as non-commissioned officers, ranking as sergeants and corporals, with pay ranging from $30 to $81 per month, according to rank. You will be right up behind the lines—as near the front as the airdomes can safely be taken.

The kind of men wanted includes chauffeurs, auto mechanicians, carpenters, electricians, coppersmiths, sailmakers, machinists, blacksmiths, metal workers, draftsmen, tool makers, welders, plumbers, painters, pattern makers, boat builders and a host of other skilled workmen.

Talk this over with your friends. Team up with your "pal," go to the nearest army recruiting station and enlist in the aviation section of the Signal Corps.

Germany to Give Subsidy for Merchant Shipbuilding

A Berlin dispatch says the Reichstag has adopted a bill for restoration of the German merchant fleet. The bill provides for a State subsidy to shipowners for reconstruction of merchant vessels.

New Coastwise Line

It is reported that a new coastwise steamship line has been organized to ply between San Francisco, Southern California, Mexico and Central America. Details have not been made public.

DISCLOSURES AT SHIPPING BOARD INQUIRY

1,427 Vessels of 8,573,108 Deadweight Tons Under Construction or Contract

According to figures given by Edward N. Hurley, chairman of the Shipping Board, before the Senate Investigating Committee, 1,427 merchant vessels of 8,573,108 deadweight tons are under construction or contract. Of these, 431 ships of 3,056,000 tons were under construction or order by private or foreign owners when the Government commandeering order went into effect on August 3. The new tonnage of steel vessels ordered is represented by 559 ships of 3,965,200 deadweight tons. The wooden ships contracted for include 379 vessels of 1,344,900 deadweight tons, while the contracts for composite ships comprise 58 vessels of 207,000 tons.

Since the commandeering order went into effect 49 vessels of a total of 300,865 deadweight tons have been completed and put into service. Before the commandeering order was issued 15 ships were delivered to foreign owners.

The prices for the various types of vesels average as follows: Steel ships, $166.48 a ton; wooden ships, $84.87 a ton (exclusive of machinery); composite ships, $133.97 a ton.

An analysis of the statistics supplied to the investigating committee by Rear Admiral F. T. Bowles, assistant manager of the Emergency Fleet Corporation, shows that on December 1 the emergency shipping programme, calling for the construction of 8,246,308 tons, was 18.2 percent completed.

The contracts of the Emergency Fleet Corporation have been let to 110 shipyards, of which 36 existed on January 1, 1917, and 74 have been created since. In addition the Emergency Fleet Corporation has requisitioned vessels which are building in 32 yards in addition to the above, so that the Emergency Fleet Corporation is at present controlling work in 132 yards, of which 58 are old and 74 are new.

This vast programme of construction was superimposed on a naval programme which was the equivalent in dollars, and therefore in shipbuilding effort, for the construction of 2,500,000 tons of merchant shipping.

The naval programme and private contracts absorbed practically 70 percent of the eighteen prominent shipyards in existence at the beginning of the war with Germany, the remaining 30 percent of these yards being taken up with the construction of merchant shipping for both foreign and domestic account. This tonnage is now being completed under the supervision and control of the Emergency Fleet Corporation.

Shipbuilding Notes

The Submarine Boat Corporation, 11 Pine street, New York, has received an order from the Emergency Fleet Corporation, Washington, D. C., to build 100 additional vessels of 5,000 tons each. This company now has contracts for 150 vessels from the Government, valued at approximately $110,000,000.

The Emergency Fleet Corporation is planning to have from fifteen to twenty-five sea-going tugs built as soon as possible for the New England coal trade.

The United States Shipping Board has approved an appropriation of $3,360,000 to be used in building barges and tugs for use on the Mississippi River.

The Union Iron Works, San Francisco, Cal., has received a contract from the Atlantic Refining Company, San Francisco, to build two oil tankers of 7,445 gross tons each.

It is reported that the American International Shipbuilding Corporation, 120 Broadway, New York, will shortly begin the construction of seventy troop ships for the United States Government. According to report these vessels will be of 8,000 tons displacement.

The United States Steamship Company, 50 Broad street, New York, is reported to have received a contract, aggregating $18,000,000, from the Emergency Fleet Corporation, to build steel and wooden vessels. In order to meet the requirements of this contract the company has purchased a location for another shipyard, which is to be located at Alexandria, Va.

Among the recent contracts arranged by the Emergency Fleet Corporation are the following:

With the Foundation Corporation, 233 Broadway, New York, twenty 4,000-ton steel unsinkable ships from designs made by a French naval constructor. It is reported that a vessel of this type successfully resisted five torpedoes dicharged into her sides.

With the Erickson Engineering Company, Seattle, Wash., ten 9,500-ton steel steamships.

With the American Shipbuilding Company, Cleveland, Ohio, thirty-six 3,500-ton steel ocean-going steamships. These will be built at the South Chicago, Ill., plant.

With the Southern Shipbuilding Company, which will build a shipyard near Charleston, S. C., and of which H. N. Whittlesey, 17 Battery Place, New York, is president, sixteen fabricated steel vessels. The amount involved in the contract is said to be $20,000,000.

With the Federal Shipbuilding Company, 71 Broadway, New York, which is owned by the United States Steel Corporation, ten 9,400-ton steel steamships.

With the Newburgh Shipyards, Inc., Newburgh, N. Y., four 5,000-ton steel steamships.

With the Los Angeles Shipbuilding & Dry Dock Company, Los Angeles, Cal., ten steel steamships in addition to those already contracted for.

With the Patterson-McDonald Shipbuilding Company, Seattle, Wash., eight 8,000-ton steel steamships.

The Matson Navigation Company, San Francisco, Cal., is planning to build new steamships to take the place of the three which have been requisitioned by the Government.

The Keystone Steel & Wire Company, Peoria, Ill., will build two steel towboats and 14 steel barges.

The Columbia Engineering Company, Portland, Ore., is reported to have received a contract from Christoffer Hannevig, Inc., 139 Broadway, New York, to build two wooden auxiliary schooners.

Mathew Bros., Belfast, Me., have received a contract from Crowell & Thurlow, Boston, Mass., to build a five-masted schooner.

The Saginaw Shipbuilding Company, Saginaw, Mich., expects to begin work immediately on the first of six ships, orders for which have been received from the Government.

Shipyard Notes

The Pennsylvania Shipbuilding Company, Gloucester, N. J.; the New Jersey Shipbuilding Company, Gloucester, and the Pusey & Jones Company, Wilmington, Del., have consolidated. Christoffer Hannevig, 139 Broadway, New York, will be president of the new company, the name of which has not yet been made public.

E. H. Gary, chairman of the United States Steel Corporation, 71 Broadway, New York, referring to the shipyard at Mobile, Ala., to be established by its subsidiary, the Tennessee Coal & Iron Company, states that ten shipways will be laid down immediately and that large wharves will be built, including power plants, boiler shops, etc. The total investment will be in the neighborhood of $15,000,000.

The Slidell Shipbuilding Company, Slidell, La., has been reorganized under the name of the Louisiana Shipbuilding Company, and its capital increased to $1,500,000.

The Merrill-Stevens Company, Jacksonville, Fla., has reorganized under the name of the Merrill-Stevens Shipbuilding Corporation, and its capital stock has been increased to $5,000,000.

The Hampton Roads Shipbuilding & Dry Dock Company, Norfolk, Va., has purchased 150 acres for the site of its shipbuilding plant.

The Gulf Shipbuilding Corporation has been incorporated, with a capital stock of $1,000,000. George V. Reilly, Arthur W. Britton and S. B. Howard, 65 Cedar street, New York, are the incorporators.

The Pacific Coast Shipbuilding Company, San Francisco, Cal., is now fully organized and has begun work on its plant at Bay Point. The company owns 2,100 acres of land. It is reported to have received a contract from the Emergency Fleet Corporation to build ten 9,400-ton steel steamships.

The International Navigation Company, W. H. Garland, president, Wilmington, N. C., has purchased 600 acres of land on the Cape Fear River as a site for a shipyard.

M. M. Davis & Son, Inc., Solomons, Md., have taken over the shipbuilding plant formerly operated under the name of M. M. Davis & Son, and are planning to increase its capacity. The New York office of the company is 366 Fifth avenue.

The Ketler-Ellicott Erection Company, Chicago, Ill., is planning to build shipyards. It is reported to have already received contracts for ten steel ships.

The Houston Shipbuilding Company, Houston, Tex., has secured a 5-acre tract of land near Harrisburg, where it will build its yard for the conctruction of ocean-going ships. Arthur Boyce, Dallas, Tex., is president.

Clement M. Egner, Elkton, Md., and associates, have incorporated the Ethel Ship Corporation.

C. Bruno Carlson and associates, San Francisco, Cal., have incorporated the Golden Gate Shipbuilding Company.

The American Shipbuilding Corporation has been incorporated at Alexandria, Va., with $10,000,000 capital. Colon H. Livingstone, 1249 Kenyon street, N. W., Washington, D. C., is president.

Alfred E. Norton, C. Nordstrom and Elmer E. Wigg, Bloomfield, N. J., have incorporated the Norton Shipbuilding Company.

It is reported that the Oceanic Shipbuilding Company, Portland, Ore., will build a shipyard at Milwaukee, Ore.

The Jancke Shipbuilding Company, Madisonville, La., is planning to build a shipyard, and is reported to have received a contract from the Emergency Fleet Corporation to build several steel steamships.

The Golden Gate Shipbuilding Corporation has been organized in San Francisco, Cal. Among the incorporators are C. B. Carlson and Victor O. Post, Oakland, and J. E. Pembert, Berkeley.

The Hydro-Submersible Corporation of America has been incorporated to manufacture submarine boats. The incorporators are Harold T. Montague, Everett A. Fretz and Reynolds O. Gilke, all of Philadelphia, Pa.

It is reported that the Government is planning to spend about $3,000,000 at the yards of the Groton Iron Works at New London and Noank, Conn.

George L. Craig, of the Craig Shipbuilding Company, Long Beach, Cal., is reported to be planning the construction of a new shipyard at San Diego.

The Martinolich Shipbuilding Company has been incorporated at Seattle, Wash., by John Martinolich and C. E. Papst.

The Da LaVergne Machine Works, foot of East 138th street, New York, has been sold to the William Cramp & Sons Ship & Engine Building Company, Philadelphia, which will use it for the manufacture of marine oil engines and refrigerating machinery.

The Racine Boat Company, Racine, Wis., and the Simmons Boat Company, Chicago, Ill., have been consolidated.

The Louisiana Shipbuilding Company has been organized at Richmond, Va. No details have been made public.

Russian Ship Registry Bureau

An organization shown as the Russian Register is in operation in Russia for the registry and classification of vessels on the inland waterways. This institution was established by nine leading transportation and insurance companies. Since its institution two more companies have joined.

Up to October 1, 1916, the number of vessels, without steam power, examined by the Russian Register was 1,363, having a total deadweight of 1,854,672 tons. The total number of vessels of this kind registered by the Russian Register was 3,499, having a total deadweight of 3,817,184 tons. The number of vessels having steam power registered up to January 1, 1916, was 1,103, with a total of 255,434 indicated horsepower.

Skinner & Eddy Launch First Ship for United States Shipping Board

Before 15,000 spectators the steamship *Seattle,* the first ship to take the water under the United States Shipping Board's contracts, was launched at the plant of the Skinner & Eddy Shipbuilding Corporation, Seattle, Wash., on Saturday, November 24, at 12:30 P. M. To commemorate the event the Shipping Board permitted this ship to be christened with the name of the city which had turned out their first product.

Under the Shipping Board contracts the *Seattle* received the official number 83, that many contracts having been awarded before the Skinner & Eddy Corporation received their six. As the *Seattle* is patterned after the same design as the other 8,800-ton cargo carriers turned out by that plant, everything was ripe for a speedy delivery of this ship, and within 77 working days after the keel was laid, Dave Rogers, the works manager, and his band of loyal workers had this ship in the water.

The sponsor for the *Seattle* was Mrs. Ernest Lister, wife of Governor Lister of Washington.

The *Seattle* is the eleventh ship turned out by the Skinner & Eddy yard in less than twenty months, number 10 being the *War Flame,* which was launched in 64 working days from the day the keel was laid, thus establishing a world's record for the construction of ships of the 8,800-ton deadweight class.

At the same moment the *Seattle* was launched the Ames Shipbuilding & Dry Dock Company, of Seattle, launched their first product, which is called the *War Brigade.*

Two more launchings are scheduled at the Skinner & Eddy plant before December 31, and during the next year it is expected that more than fourteen ships will be sent down the ways at this plant.

Officers the Greatest Need of the Navy

At the recent graduation of 192 ensigns in the naval reserve the Secretary of the Navy stated that on September 1, 1916, the total enlisted strength of the Navy and Marine Corps, including men and officers in the regular service and in the reserve ranks, was 74,542. On September 1, 1917, the number was 232,930. We have to-day in the navy all the men we need until ships under construction and repair are furnished and put in commission. The greatest need, therefore, is for officers who know how to sail a ship, how to man its guns, how to organize it to fight.

Since the war began the Naval Academy has been doubled, but to-day its facilities are inadequate to graduate officers as rapidly as they are needed. This, too, after we graduated two classes this year. Other sources, therefore, must then be relied upon for officers in emergency.

The first reliance is upon retired officers who have Naval Academy training, but who have been retired by the age limit or for some illness that did not enable them to perform all the duties of a naval officer afloat or ashore.

The second source of supply for capable naval officers is from the ranks. Within the past two months 794 capable men have been commissioned as ensigns or junior lieutenants, and from this wonderful body of exceptional warrant officers the navy will find men worthy of the commissions they have earned.

The third source to which the navy looks for officers is to the well-organized Naval Militia.

Southern School of Nautical Sciences Opened

A College of Nautical Sciences, with about fifteen instructors on the faculty, was recently opened at 6363 St. Charles avenue, New Orleans, La., offering to young ment of the South an opportunity to study ship drafting, marine engineering, ocean navigation and seamanship.

The course in ocean navigation will cover a period of five months, and the courses in ship drafting and marine engineering periods of seven months each. The classes will be held in the evening, enabling young men to engage in shop or engine-room practice, so as to combine the practical with the theoretical side of the vocations.

To meet the needs of the rapidly-growing shipping and shipbuilding industries in the Gulf States this school will fill a most important mission, and it is expected that the attendance to the classes will be large, as no less than ninety men applied for admission at the opening of the school.

Nearly 10,000 Lives Lost on British Merchant Vessels

It is announced that the number of lives reported as lost on British merchant vessels owing to enemy action from the beginning of the war until June 30 last is 9,748.

SKILLED MECHANICS WANTED IN GOVERNMENT NAVY YARDS

Ship Fitters, Anglesmiths, Blacksmiths and Machinists Especially Needed

The United States Civil Service Commission issues the following:

Nearly 55,000 appointments were made to the forces of mechanics, helpers and laborers at navy yards and other naval establishments during the fiscal year ended June 30, 1917, and since that date appointments have been made in increased proportion.

An appropriation of $7,500,000 is now being expended in the enlargement of the great naval gun factory at Washington, which, when completed, will furnish employment for 4,000 or more skilled mechanics, in addition to the 8,000 already at work in the plant. In this mammoth factory, one of the best equipped and most interesting in the world, are built the great guns for our war vessels, which carry to every country the message of America's ability to protect herself and to safeguard the rights of her citizens wherever they may be.

Copyright by Press Illustrating Service, Inc., N. Y.

Photograph Taken from British Airplane, Showing Effect of Bombs Dropped on on Marine Terminals of Enemy Seaport

PHILADELPHIA AIRCRAFT FACTORY

The new naval aircraft factory at Philadelphia, which will be completed this month, will also employ about 3,000 men.

The workers who man such plants are of a superior class, and they feel a personal pride in turning out products that will stand the test of conflict with the arms of other nations. A considerable part of the building of war vessels is also done in Government yards.

The United States Civil Service Commission, which is charged with the task of recruiting the ranks of this great

civilian army, through its widespread organization, is furnishing the men as they are needed. In certain trades, particularly those connected with shipbuilding, there is usually a shortage. Sailmakers, coppersmiths, ship fitters, anglesmiths, blacksmiths and machinists are especially needed. Women to operate power sewing machines are also in great demand.

URGED TO OFFER SERVICES

The representatives of the Civil Service Commission at the postoffices in all cities are the official recruiting agents for this as well as other branches of the civil service. The Commission urges competent mechanics to offer their services to the Government at this time of great need.

Type 4-1000 Oxygen-Hydrogen Generator, Manufactured by the International Oxygen Company

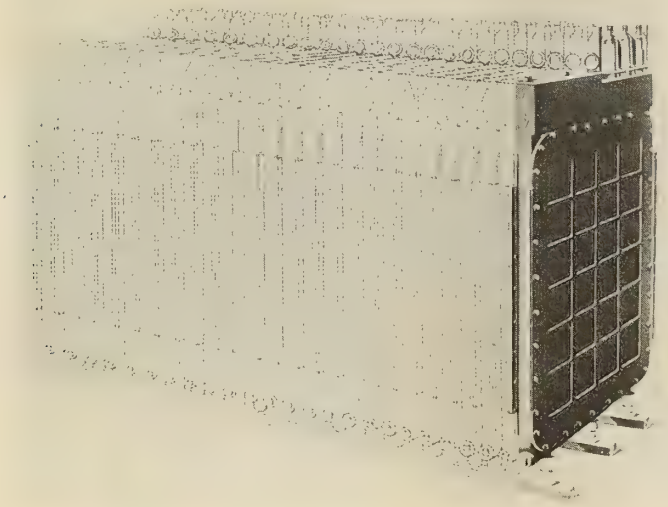
In this new electrolytic gas generator the manufacturers have adopted no new scientific principles but have introduced such radically-new departures in the construction features as to have created an entirely new type of apparatus. The most conspicuous feature of the Type 4-1000 cell is its compactness—the dimensions being approximately 3½ inches thickness, 3½ feet width and 6 feet high. The capacity of this cell, under 1000 amperes of current, is approximately 200 cubic feet of oxygen and 400 cubic feet of hydrogen per 24 hours, this generating capacity requiring almost exactly 1 square foot of floor space. The illustration indicates the size of a battery of 25 cells with a total 24-hour capacity at 1,000 amperes of 5,000 cubic feet of oxygen and 10,000 cubic feet of hydrogen, the floor space requirement being about 3½ by 7½ feet.

The second unique feature of the Type 4-1000 generator is its operating flexibility. Any current may be used, from less than 200 amperes to upwards of 1,000 amperes, with a corresponding variation in gas output, thus giving the generator a production range of more than 5 to 1. The normal operating current is stated as 600 amperes, because, generally speaking, at this current the most economical compromise is had between first cost and operating cost. Below 600 amperes the electrical efficiency increases slightly while the production per cell decreases. Above 600 amperes electrical efficiency falls off slightly but the output per cell increases. At 600 amperes the kilowatt-hour efficiency is 3.65 cubic feet of oxygen and 7.3 cubic feet of hydrogen per cell.

The flexibility of the Type 4-1000 generator has this important commercial value: Where current can be had at low cost the plant can be operated at high amperages, giving the requisite gas output from fewer cells; where current cost is high the generators can be run on lower amperage, requiring more cells. In a given plant, at periods of low demand, current can be saved by running at a lower amperage and higher efficiency. Under excess demands the output can be increased from the same battery of cells by using higher amperage at slightly lower efficiency.

The guaranteed purity of the gases from the Type 4-1000 generator is: Oxygen, 99 percent pure or better; hydrogen, 99.5 percent pure or better. Average service results show oxygen 99.6 percent pure and hydrogen 99.8 percent pure. There is absolutely nothing in the construction to wear out or deteriorate either from long use or high temperature; no organic materials whatever are used. The cost of installation, including first cost, freight charges and installation expense, is lower than that of any other oxyhydrogen generator of any type. This, it is claimed, coupled with the exceptional electrical efficiency and flexibility, and the practical elimination of repair and replacement costs, enables the owner of a Type 4-1000 generating plant to secure the maximum volume of purest gases at the minimum total cost and with absolute security against interruption of service except by complete failure of current supply.

The new generator is the product of the International Oxygen Company, 115 Broadway, New York.



Electrolytic Gas Generator Manufactured by International Oxygen Company

Swiss Merchant Marine Planned

Business men in Switzerland are planning for the creation of a Swiss merchant marine to engage in trade with North and South America via the ports of France after the war. A Swiss ocean committee has been appointed, whose object is the improvement of relations by rail and by sea between Switzerland and the Americas by utilizing the French ports of the Atlantic.

Marine Terminals

The city of Seattle, Wash., A. H. Dimock, City Engineer, will soon vote $160,000 in bonds to enlarge the Bell street wharf.

The Board of Harbor Work Commissioners, Newark, N. J., is planning to build a 1,200-foot pier at the Port Newark Terminal, to cost about $450,000.

Largest Dry Dock in Argentina Completed

According to press dispatches from Buenos Aires, the largest dry dock in Argentina, located at Puerto Militar, near Bahia Blanca, has been completed and successfully tested under the supervision of a board of officers of the Argentine Navy. Actual construction of the dock was begun in the latter part of 1911.

New York Shipbuilding Corporation Insures Employees

The New York Shipbuilding Corporation, Camden, N. J., has adopted a plan of insurance for all employees, paying the premiums and bearing all expenses with funds accruing to the family of the employee in case of death.

Those who have worked at the plant for less than two years have been insured for $500, and for every additional year this amount is increased $100.

Record Year for Delaware Shipyards

Six of the largest shipyards on the Delaware will have launched in the year 1917, 307,604 tons of shipping, representing an approximate value of nearly $77,000,000.

These same shipyards have on their books contracts aggregating 823,081 tons, representing an approximate value of nearly $206,000,000. Fully 70 percent of the 1918 contracts are for the United States Shipping Board.

New Ocean Terminals to Be Built for Emergency Fleet

The Council of National Defense has created an advisory commission on terminal facilities to work with the General Munitions Board and with the special committee of the Board on Storage Facilities. Francis Lee Stewart, consulting engineer, formerly chief engineer of the Baltimore & Ohio Railroad, who represents the ports of Baltimore, will be chairman of the commission.

The committee is making a study of the ocean terminals of the country for the use of war supply vessels, and it is understood that new terminals are to be built especially for the assembling and loading of supplies for American ships abroad and for the allies.

Mechanical Engineers Elect New Head for Coming Year of War Activities

Charles T. Main, of Boston, a consulting engineer who has served in several public offices for the purpose of advancing the idea of good government, has been elected president of The American Society of Mechanical Engineers, which includes in its membership 8,500 mechanical engineers. Mr. Main was born in Marblehead, Mass., in 1856, and was educated at the Massachusetts Institute of Technology, from which he was graduated in 1876. Since 1892 he has practiced as a consulting engineer, with offices in Boston, until 1907 being associated with F. W. Dean in the firm of Dean & Main.

Photograph copyright by Press Illustrating Service, Inc., N. Y.

Alexander M. Carlisle, designer of the *Titanic*, *Britannic* and other famous Trans-Atlantic vessels.

C. W. Cook Appointed Assistant Director of Shipping for Pacific Coast

C. W. Cook, formerly Pacific Coast manager for the American-Hawaiian Steamship Company, and for many years prominent in San Francisco shipping circles, has been appointed assistant director of shipping operations for the Shipping Board on the Pacific Coast. Mr. Cook will have supervision of the operations of vessels on the Pacific Coast, and will also exercise direction over the progress of shipbuilding for the Emergency Fleet Corporation.

Correction

It was erroneously stated on page 565 of our December issue that the Great Lakes Engineering Works, Detroit, Mich., was erecting a new shipyard at Seattle for the purpose of building vessels of about 9,400 tons deadweight capacity for the Emergency Fleet. While this company's entire programme of shipbuilding now under contract is for ocean service, the vessels will all be built in its three large shipyards on the Great Lakes, all of which are being extensively enlarged. The present contracts which the company now has will average delivery of one ship every two weeks during the year 1918.

Personal

EDWIN B. SADTLER, New York agent of the New York Shipbuilding Corporation, Camden, N. J., has resigned to open an office in the Woolworth building, New York City, as a consulting marine engineer and naval architect.

L. F. HAMILTON, for the past nine years manager of the advertising and specialty department of the National Tube Company, Pittsburg, Pa., resigned on December 1 to become associated with the Walworth Manufacturing Company, Boston, Mass., as advertising manager.

W. L. SCHAEFFER has succeeded L. F. Hamilton, in charge of the advertising department of the National Tube Company, Frick building, Pittsburg, Pa.

EDWARD F. GOLTRA, president of the Mississippi Valley Iron Company, St. Louis, Mo., has been made a member of the Committee of the Upper Mississippi River Improvement Association, which has been formed to determine a feasible way to rehabilitate the river traffic.

LOUIS W. CARVER, for the past two years purchasing agent for the Chester Shipbuilding Company, Chester, Pa., has become associated with the purchasing board of the United States Shipping Board.

CHARLES I. IRWIN, formerly connected with the American-Hawaiian Steamship Line, has been appointed chief engineer for the San Francisco division of the United States Shipping Board.

J. W. MURRAY, formerly port captain of the American-Hawaiian Steamship Line at San Francisco, has been appointed port superintendent for the United States Shipping Board at San Francisco.

Photograph copyright by Press Illustrating Service, Inc., N. Y.

Charles Piez, Vice-President and General Manager Emergency Fleet Corporation

CAPT. WILLIAM FISHER, formerly in command of the Pacific Mail steamship *Korea*, has been appointed inspector of hulls for the United States Steamboat Inspection Service for the district of Washington, with headquarters at Seattle, Wash.

CAPT. B. B. WHITNEY has been appointed Northwest representative of the American Bureau of Shipping.

Photograph copyright by Press Illustrating Service, Inc., N. Y.

Charles R. Page, of California, new member of Shipping Board

THE CHESTER SHIPBUILDING COMPANY, LTD., Chester, Pa., announced on December 7 the following members of its organization: Chairman board of directors, W. A. Harriman; president, R. H. M. Robinson; vice-president and comptroller, C. B. Seger; vice-president, C. W. Hamilton; secretary and assistant to president, J. A. Kissick, all of 165 Broadway, New York; treasurer, A. D. Wagner; general manager, W. T. Smith; assistant general manager, E. L. Fries; assistant general manager, L. T. Kniskern; consulting engineer, C. P. M. Jack; engineering manager, Max Willemstyn, all of Finance building, Philadelphia, Pa.; auditor, E. M. Sawyer, Chester, Pa.

FRANK W. HALL has been appointed commercial manager of the Sprague Electric Works of General Electric Company. With the exception of a short period Mr. Hall has been connected with the Sprague Works continuously for twenty-two years in various engineering and sales capacities, and for the three years prior to his present appointment occupied the position of sales manager. D. C. Durland, former executive head of the Sprague Electric Works, has resigned to accept the presidency of the Mitchell Motors Company, Inc.

JOHN MACDOWELL, formerly chief inspector of hull construction for the Standard Transportation Company, of New York, has been appointed by the United States Shipping Board Emergency Fleet Corporation inspector in charge of hulls at the New York Shipbuilding Corporation, Camden, N. J.; the Pennsylvania Shipbuilding Corporation, of Gloucester, N. J., and the New Jersey Shipbuilding Company, Gloucester, N. J., with Charles F. Holden and Otto Ryerson as assistants.

SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

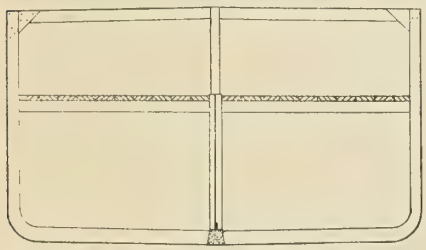
American patents, compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,233,237. PROTECTING MEANS FOR SHIPS OR VESSELS. ALBERT C. HOLZAPFEL, OF NEW YORK, N. Y.

Claim 1.—The combination with the hull of a ship or vessel, of a protecting belt secured thereto, comprising a skin, an inner group of substantially hermetically sealed air containing tanks, and an outer filling of soft and light wood arranged between said group and the skin. Three claims.

1,233,380. SHIP CONSTRUCTION. ALEXANDER McDOUGALL AND ALEXANDER MILLER McDOUGALL, OF DULUTH, MINN.

Claim 1.—In a ship's hull of substantially rectangular shape in cross section, a plurality of floor beams spaced apart upon the bottom



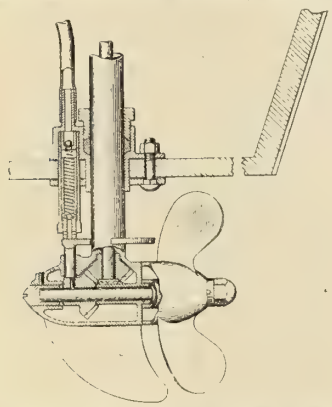
of the hull, a central fore and aft bulkhead fixed to the uppermost edges of the floor beams and a watertight concrete wall between the bulkhead, the bottom and the floor beams. Fifteen claims.

1,213,153. SUBMARINE STEERING APPARATUS. ANDRÉ CITROEN, OF PARIS, FRANCE, ASSIGNOR TO SOCIETE ANONYME DES ENGRENAGES CITROEN, OF PARIS, FRANCE, A CORPORATION OF FRANCE.

Claim 1.—In steering mechanism for ships and the like, the combination with a rudder shaft, of a frame mounted on the shaft, actuating mechanism for said shaft supported by the frame, and means to brace the frame and prevent the same from freely swinging about the axis of said shaft. Five claims.

1,234,370. PROPELLING ATTACHMENT FOR CANOES, ROWBOATS, ETC. CHRISTOPHER J. MEYER, OF WAUWATOSA TOWNSHIP, COUNTY OF MILWAUKEE, WIS., ASSIGNOR TO EVINRUDE MOTOR COMPANY, OF MILWAUKEE, WIS., A CORPORATION OF WISCONSIN.

Claim 1.—A clamping member for boat propeller attachments, provided with a bushing adapted to receive an inclosing sleeve for a



driving shaft, and also having a pump cylinder; said bushing and pump cylinder projecting from said clamping member in position for insertion through contiguous apertures in the hull of a boat. Fifteen claims.

1,209,640. HYDROPLANE-BOAT. CLINTON H. CRANE, OF HEWLETT, N. Y., ASSIGNOR TO J. FREDERICK TAMS AND CHARLES KING, DOING BUSINESS UNDER THE FIRM NAME OF TAMS, LEMOINE & CRANE, OF NEW YORK, N. Y.

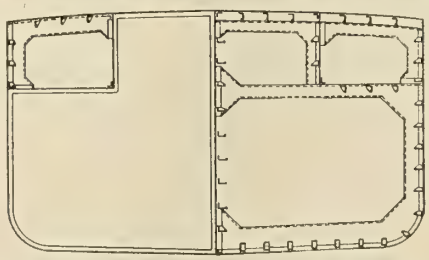
Claim 1.—A hydroplane boat provided with a fixed forward plane member, a wholly submerged after plane member secured to the propeller struts, and riydly set at a predetermined angle in conjunction with the angle of the forward plane member, a second after plane member directly superimposed above, and of larger area than, said submerged plane member secured to the propeller struts and rudder post, and adapted to rise to, or above, the surface of the water as the speed of the boat increases, and a rudder mounted between said after plane members. Four claims.

1,233,381. SEA-GOING CANAL BOAT. ALEXANDER McDOUGALL AND ALEXANDER MILLER McDOUGALL, OF DULUTH, MINN.

Claim 1.—A ship's hull, quadrilateral in cross section from stem to stern, straight sides in the bow thereof, and inclined sides and bottom in the stern thereof. Five claims.

1,234,675. SHIP FOR CARRYING LIQUID CARGOES IN BULK. HUGH LAING AND EDWARD WILKINSON ASHBY, OF SUNDERLAND, ENGLAND.

Claim 1.—A bulkhead construction for a liquid cargo carrying ship of the type known as a "tanker" comprising not less than one longitudinal bulkhead dividing the cargo space into longitudinal compartments, and not less



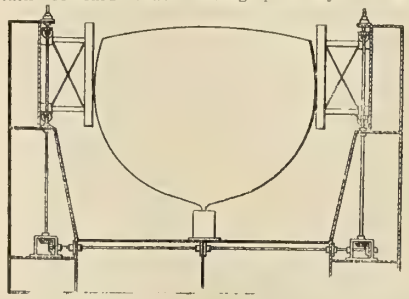
than one transverse bulkhead subdividing said longitudinal compartments, the portions of each transverse bulkhead on each side of a longitudinal bulkhead being out of line the one with the other. Seven claims.

1,216,549. SHIP PROPELLER. MATTHEWS E. DAVIS, OF NEW YORK, N. Y.

Claim 1.—The compination of an iron or steel hull, with a steel propeller shaft having a fixed sleeve insulated from the hull; a propeller shaft having a fixed sleeve insulated from the hull; a propeller keyed to and also clamped endwise in place on the shaft; and a gasket between the opposed walls of the sleeve and propeller hub; the propeller comprising an iron or steel propeller-shaped core and a copper-containing metal coating on its surfaces, and the hull being provided with removable zinc plates adjacent the propeller; the copper-containing metal coating resisting pitting and preventing pitting of the coated propeller core and of the portion of the shaft in the propeller hub bore; and the zinc plates in proximity to the propeller protecting the hull against electrolytic action; and the gasket excluding water from access to the shaft at the joint between the opposed walls of said sleeve and propeller hub; and the said metallic coating increasing the strength of the blades cross-sectionally

1,235,089. MEANS FOR ADJUSTING AND SHORING SHIPS IN DRY SETTING. ANDERS FREDRIK WIKING, OF STOCKHOLM, SWEDEN.

Claim 1.—In a dry dock, vertical shoring beams, braces pivotally attached thereto, certain of said braces being pivotally attached



to the walls of the dock, carriages slidable parallel to the wall of the dock to which the other braces are pivotally attached, and means for sliding said carriages whereby the shoring beams may be moved toward or away from the center of the dock. Three claims.

1,205,766. BOAT-LAUNCHNG DEVICE. ALLEN E. J. LUCKHURST, OF RIDGEWOOD, N. J.

Claim 1.—In a boat launching device, gearing mounted on the davit adapted to rotate the same, means carried by said davit to operate said gearing, and means independent of any operating parts to hold said operating means in fixed relation to the ship. Nine claims.

1,223,154. METHOD OF RENDERING SHIPS UNSINKABLE. WILLIAM T. DONNELLY, OF BROOKLYN, N. Y.

Claim 1.—The method of loading ships, which consists in confining to such an extent only that it will float in water and will afford its between decks watertight container and loading container with cargo portion of the buoyancy required to maintain the ship afloat when water logged. Two claims.

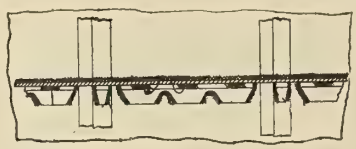
British patents compiled by G. E. Redfern & Co., chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

107,247. "IMPROVEMENTS RELATING TO THE WATER-TIGHT DOORS OF MOTOR-DRIVEN VESSELS." E. RINGSTED, 52, RANDOLPH GARDENS, BROOMHILL, GLASGOW, AND BARCLAY, CURLE & COMPANY, LTD., WHITEINCH, GLASGOW.

This invention relates to an improved mode of operating the water-tight doors of motor-driven vessels having engines of the Diesel or like type. Under this invention, compressed air is led by a pipe connection from the compressed air pump of the Diesel or like motor engine through an automatic reducing valve to a compressed air reservoir, from which again air pipes pass to the various watertight doors of the ship. Valves are provided in connection with these pipes so as to control the air supply to the operating mechanisms of the doors, these valves being operable from the bridge or other suitable part of the ship in any well-known and suitable manner.

108,189. IMPROVEMENTS RELATING TO SHIPS' DECK STRUCTURES, BULKHEAD STRUCTURES, AND THE LIKE. THE QUASI-ARC COMPANY, LIMITED, MANUFACTURERS, AND W. L. COLE, ENGINEER, BOTH OF CAXTON HOUSE, WESTMINSTER, LONDON.

For inserting and securing in place in a watertight manner the decks, bulkheads and the like of a ship, brackets are welded to the ship's plating at a level to support the deck or



the like, and any re-entrant spaces in the ship's frame members are filled in with insertions welded into place at the deck level, after which the deck when inserted is secured and rendered watertight by a fillet of welding metal deposited around the whole of its edge against the ship's plating and against the frame members and filling insertions therein.

107,779. IMPROVEMENTS IN REVERSIBLE BOATS. T. H. GASKIN, OF WELLINGTON VILLA, GROVE ROAD, WOODFORD, ESSEX, BUILDER.

This invention relates to reversible boats or rafts adapted for being carried on shipboard and capable of being used in place of the ordinary non-reversible lifeboats with which ocean-going vessels are as a rule provided. The reversible boat has two separate decks, each of which occupies the entire area of the corresponding well of the boat; both the peripheral buoyancy chamber and also the supplementary buoyancy chamber constituted by the space between the decks, serving to accommodate a series of hermetically sealed air tanks, which are independent of the structure of the boat.

103,860/16. "METHOD OF AND APPARATUS FOR MINIMIZING THE DAMAGE TO A SHIP WHEN WATER ENTERS ANY COMPARTMENT." A. J. F. LEE, OF 204, GIROUARD AVENUE, NOTRE DAME DE GRACE, MONTREAL, CANADA, COMPRESSED AIR SALVAGE BROKER.

In specification No. 281, of 1915, means are described by which, in vessels provided with a supply of air under pressure, and in which the separate compartments of the hold are constructed so as to be individually air tight, in case of any damage to the hull causing an inflow of water to any compartments, the valves controlling the admission of air to such compartments are opened, either manually or automatically, and air is admitted, which acts as a cushion to hold back the water or to force it down to the highest point of the break and thus keep the vessel afloat until repairs can be effected. According to the present invention, means are provided for maintaining, when the hatches are closed, a constant flow of air through the compartments, such means comprising pipes opening into the lower parts of the under-water compartments and communicating with the exterior, and means for controlling the flow of air through the said pipes.